

# **Overview of 2003 Pesticide Sales in Alberta**

**Environmental Assurance Division  
Alberta Environment**

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# **Overview of 2003 Pesticide Sales in Alberta**

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## EXECUTIVE SUMMARY

Alberta Environment undertook the collection, consolidation and analysis of pesticide sales data from pesticide vendors in Alberta for the 2003 calendar year. The objective was to document the volume and types of pesticides sold in Alberta, and to prepare a general overview of the sales data in relation to sectors of use, types of use, individual active ingredients, chemical groupings, as well as geographic breakdowns by river basin and municipality. This project is an ongoing survey conducted every five years, with previous reports being done for 1993 and 1998. The 1998 report followed the chemical grouping format used by Quebec in their reporting on pesticide sales in their province, and with the proposed National Pesticide Sales Database, however the 2003 report also includes individual active ingredient sales information.

Pesticide sales data was requested from registered pesticide vendors and wholesalers in Alberta in early 2004, under the authority of the Environmental Protection and Enhancement Act and supporting regulations. Approximately 92% compliance with the sales data request was obtained. Sales data received was digitized or reformatted to a common database format. Six additional datasets were constructed to assist with sorting and categorizing the sales records by chemical or geographic groups. The datasets were brought into Microsoft Access, where they were linked and various queries were performed.

In 2003, a total of 9 264 487.7 kg of pesticide active ingredient (ai) was sold in, or shipped into, Alberta. Pesticides sold into the Agriculture sector accounted for 96.2% of all pesticides sold, with the Commercial/Industrial sector accounting for 3.1% of sales, and the Domestic sector accounting for 0.6% of sales. The types of pesticides sold were predominantly herbicides, at 77.3%. Adjuvants and surfactants made up the next largest category at 14.6%. Insecticides made up 4.7% of sales, while fungicides made up 3.4% of sales.

Of the chemical groups, the Phosphonic Acids, Phosphinic Acids group was the largest at 38.1% of overall sales. Sales in this group were made up primarily of glyphosate. However, in the Domestic sector, the Phenoxy Acids group dominated with 35.2% of pesticide active ingredient (mainly 2,4-D) sold.

Looking at geographic distribution of sales by outlet location related to major river drainage, sales in the Oldman River basin were highest overall at 21.4% of the total, followed by sales within the Red Deer River basin at 17.6%, the North Saskatchewan River basin at 15.0%, and the Battle River basin at 14.6%.

Pesticide sales were also sorted by natural regions. The Grassland Natural Region constituted over 46% of all pesticide sales, mainly in the Dry Mixedgrass and Mixedgrass sub regions. The Parkland Natural Region contained almost 39% of provincial pesticide sales, mainly in the Central Parkland sub-region. The



majority of the remainder of pesticide sales was in the Dry Mixedwood sub-region of the Boreal Natural Region.

Geo-administrative regions were also summarized, for use in program planning. The municipalities with the highest sales were the County of Lethbridge and the MD of Taber, at over 500,000 kg of active ingredient. Based upon their cropped acreage, total pesticide use intensities of over 2.5 kg ai/ha were estimated for these municipalities.

This compares to an overall provincial estimated agricultural pesticide use intensity (based upon cultivated land acreage) of 0.78 kg ai/ha, comparable to the 0.79 kg ai/ha agricultural pesticide use intensity calculated for 1998. Other municipalities with over 300 000 kg ai of agricultural pesticide sales were the Counties of Forty Mile and Vermilion River, as well as Kneehill County and Vulcan County. Estimated pesticide use intensities for these municipalities ranged from 0.97 to 1.50 kg ai/ha. These municipalities may also serve as regional supply centres, so the use intensity estimates may be an overestimation.

The overview of pesticide sales data for Alberta has provided Alberta Environment and other agencies with the background data to enable comparisons to other regions, and to assist in ensuring that Alberta Environment has the appropriate regulatory framework in place for pesticides. The data will also be useful in identifying monitoring priorities for ongoing and upcoming monitoring programs.

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## 1.0 INTRODUCTION

Alberta Environment initially collected pesticide sales information for the period 1988-1993 from major agricultural retailers (Cotton and Byrtus, 1995), and used this information to enhance the pesticide monitoring carried out by AENV in surface waters (Anderson 2005), and to assist in the development of a major surface water monitoring program conducted from 1995-1996 (CAESA 1998). While this data was limited to about 50% of agricultural product sales, it did provide trend information and spatial perspective on certain products. In 1998, a more comprehensive review of pesticide sales in Alberta was conducted and encompassed the agricultural, domestic, commercial livestock and structural sectors (Byrtus 2000). This information was used in the updating of pesticide monitoring programs, for surface water monitoring conducted by AENV, AESA, as well as treated water monitoring programs operated by AENV. In addition, domestic sales data was extracted to provide extensive information on pesticide use by major urban centres in Alberta.

In 2003, Alberta Environment undertook its third provincial scale review of pesticide sales; using the same data collection and reporting process as was implemented for 1998. Updates to the databases used for the cross referencing the sales records to chemical and spatial information was conducted.

The data in this overview will assist Alberta Environment and other provincial and federal agencies in comparisons of pesticide sales/usage information. It will also help to identify monitoring priorities for ongoing monitoring programs and assist in planning for new programs. It will also assist Alberta Environment in ensuring that the appropriate regulatory framework is in place for the pesticides in current use in Alberta.

The specific objectives of this project were:

1. To assemble pesticide sales records representing pesticide use for the calendar year 2003.
2. To categorize pesticide sales by chemical group, sector of use, and geographic distribution

## **2.0 METHODS**

### **2.1 Sales Data**

#### **2.1.1 Sales Data Collection**

Alberta Environment maintains a registry of pesticide vendors that retail restricted and commercial registered pesticide products, as well as wholesale distributors of domestic class products. This registry is maintained as a component of the Environmental Management System (EMS), which tracks many of the approvals and registrations issued by Alberta Environment that fall under the Environmental Protection and Enhancement Act (EPEA). Under the authority of this Act and its supporting regulations (Pesticide (Ministerial) Regulation), Alberta Environment can request pesticide sales records from vendors.

A letter was sent out to all registered vendors in Alberta and wholesale distributors in early 2004 requesting pesticide sales in Alberta for the calendar year 2003. Sales data was received throughout 2004 in various formats (hard copy and electronic). Records were received from approximately 92% of vendors sent request letters. Several vendors had changed ownership during 2003, complicating the sales data retrieval.

Hard copy records were manually entered into a standardized Excel file, while digital files were converted to the standardized database format. Regardless of the data format, the vendor approval number, product registration number, quantity sold in litres or kilograms and sector of use were recorded for each entry. Individual vendor data files were consolidated into a single sales database, which contains almost 65,000 records.

#### **2.1.2 Sales Data Limitations**

##### *Sector Representation*

The data from vendors that are primarily agricultural suppliers may have also contained sales to the landscape industry, the industrial sector, municipal governments, golf courses and other non-agricultural sectors. As a result, the agricultural sector may be slightly over-represented, while the other sectors may be slightly under-represented for those products that have cross-sector utilization. Products that were sold by agricultural retailers, but that were only registered for non-cropland uses were classified to the Commercial/Industrial sector.

### *Treated Seed*

Sales of fungicide and insecticide treated seed was not targeted in this survey, however some sales records of treated seed were received, converted to a pesticide active ingredient equivalent, and reported. The collection of treated seed sales data was beyond the scope of this project, particularly as seed distribution is often done by seed vendors or seed divisions (not specifically regulated under EPEA) rather than agricultural chemical divisions of the line companies. Most of the products used for custom seed treatment at seed cleaning plants are captured in this survey.

### *Vendor List*

The vendors surveyed were based upon the vendors contacted in 1998, along with an updated list from the EMS system, which was also cross-referenced to the list of CropLife certified warehouses, supplied by the Agricultural Warehouse Standards Association. Because of regulatory reform, not all pesticide vendors are registered under EPEA or under the CropLife warehouse program. For example, many of the livestock products have been exempted from vendor registration requirements. Therefore, the livestock product information is not complete. Also, the sales of disinfectants, anti-microbial products and wood preservatives are exempted from requiring a vendor registration, so there is virtually no sales data on those products.

### *Domestic Products*

The sales records obtained from the agricultural and industrial sectors were considered reasonably accurate in terms of product sold, as they were obtained from systems reporting the point of sale for each product. On the other hand, domestic sales records came from distributors and wholesalers, so there is some outlet based information, and some records based on sales or shipments within the province. Most wholesale records consisted of case lots, and because it is not known how much product came out of individual store inventory in the spring, and went into inventory in the fall, it was assumed that the product shipped to the various domestic retail outlets in 2003 was sold in 2003. Also, some products were shipped through regional distribution systems, and that information was not accessed during the 2003 survey.

In the domestic sector, pet care products, spa and pool products, and most wood preservatives (paints and stains) sold in Alberta were not identified in this survey. Some miscellaneous household (indoor) pesticides were also missed in this survey, as they are classified as Schedule 4



products, which have been exempted from the provincial regulations as far as requiring wholesale vendor registrations, or retail dispenser certification.

#### *Geographic Non-Specific Records*

Some vendors were unable to identify retail outlets for their shipments for a variety of reasons. These sales data were identified as "Alberta", and as a result, would not be included in any geographical breakdown. These records would, however, be included in sector summaries, active ingredient listings, and chemical group summaries.

### **2.2 Pesticide Databases**

In order to consolidate pesticide formulation sales information down to active ingredient and to chemical group, two separate databases were also incorporated. The first of the pesticide databases was the pesticide Product database, which was originally obtained from the Pesticide Management Regulatory Agency in 1998, and updated with pesticide registrations issued up to and including 2003. Registrations for fertilizer-pesticide combinations under the Fertilizer Act were also added to this database. This database has information required for this project on the product registration number, active ingredient, guarantee, as well as product name, registration status, etc. This database currently has 15 615 records. The second pesticide database was the Active database, which included active ingredient codes, active ingredient names, chemical family and chemical group. There are a total of 641 records in this database, however this includes disinfectants, antimicrobials and a number of historical active ingredients that are no longer registered or sold in Canada.

### **2.3 Geographic Databases**

Four databases were used to identify the geographic distribution of pesticide sales information. The primary database was the Vendor database, which included the vendor registration number, along with the vendor name and location (e.g., city, town, village or hamlet). As a number of sales records were received for vendors that do not require vendor registrations in Alberta (primarily domestic retail vendors), dummy vendor numbers were also generated for these. Dummy vendor numbers were also generated for all municipalities in Alberta to enable geographic identification of minor vendors, or sales records to end users. Another major database was the City database, which lists all the municipalities in Alberta. Associated with each municipality was the corresponding reference for rural municipality, drainage basin, and

ecodistrict. Secondary databases included Basin (which cross-referenced drainage basin and river basins), and Natural Region (which cross-referenced ecodistrict and natural regions).

## **2.4 Data Processing**

The databases and spreadsheets were imported into Microsoft Access for data processing and querying. The databases were linked by related fields to calculate active ingredient values, and subsequent data groupings by chemical group, sector of use, and geographic distribution (see Cotton and Byrtus 1995 for an example of how the calculations were done). Conversion of formulated product sales to kg of active ingredient (ai) is a common means of expressing pesticide sales/use in other jurisdictions (Gregoire 1997), although actual reporting is sometimes by chemical group or by sector of use instead of by quantities of individual active ingredients.

Assumptions were made with respect to pesticide formulations, such as the specific gravity of all pesticide formulations being 1.0. In 1998, *Bacillus* formulations were assumed to be 100% active ingredient. Information on actual percentages of active ingredient on a volume basis was obtained for products sold in 2003, so *Bacillus* formulations are reported here as active ingredient instead of formulated product.

Products that contain more than one active ingredient were assigned an extension number to the PCP (Pest Control Products) number for each of the active ingredients involved in both the sales and product databases. This enabled the use of the existing registration numbers with only a minor modification, and also enabled the software used for the data processing to accurately identify each component of a formulation. However, this resulted in additional records being added to the sales database to account for each active ingredient in a formulation (approximately 20,000 records).

## **2.5 Data Breakdown**

In order to simplify the analysis of the data, consolidation of the data based upon type of use, chemical group and sector of use was undertaken.

### **2.5.1 Type of Use**

Under the PCP Act, pesticides are classified into 39 product types (herbicides, insecticides, fungicides, etc) of products, which reflect their type of use. For the purpose of this document, the categories have been reduced to 6 primary types of use. All of the active ingredients identified in

sales made in Alberta in 2003 are included in one of the types of use listed here. For those active ingredients that have multiple types of uses (such as thiram, which is a fungicide and a vertebrate repellent), the product is listed under its primary usage for Alberta.

- Herbicides and plant growth regulators
- Insecticides, acaricides, repellents,
- Fungicides
- Vertebrate control products and vertebrate repellents
- Adjuvants/surfactants
- Other: (Soil fumigants, wood preservatives, disinfectants, anti-microbials)

As the primary focus of this survey was on traditional pesticides, and not anti-microbial or disinfectant pesticides, sales data from industrial and domestic cleaning agents were not obtained or included, although these are also registered under the PCP Act. Adjuvants and surfactants are widely used in the agricultural industry in Alberta, so these records were included as a separate category.

### **2.5.2 Chemical Group**

The chemical groupings (listed below) used for this overview are based primarily upon the groups established by the National Pesticide Sales Data Base, using an interim list dated February of 2000 (Appendix 1). This list is still under review, and could be subject to further changes. This list is derived from a variety of sources, with the main source being the list used by Quebec in their pesticide sales groupings (Gorse 1999), although there are a number of minor differences in the chemical groups used here and by Quebec. Several of these groups contain more than one chemical family. For example, the Amides, Anilines group contains compounds from the anilides, amides and benzamides families.

#### Chemical Groupings Used In This Overview

- |   |                                       |
|---|---------------------------------------|
| • Alcohols  | • Carboxylic Acids                    |
| • Amides, Anilines                                  | • Chlorophenols                       |
| • Amino Acids                                       | • Chromenones                         |
| • Ammoniums, Quaternary                             | • Cyclohexanedione Oximes             |
| • Aryloxyphenoxyl Acids                             | • Diazines, Quinoxalines, Morpholines |
| • Azoles, Diazaoles, Oxazoles, Thiazoles, Triazoles | • Dicarboximides, Oxathiin            |
| • Bacillus thuringiensis                            | • Dithiocarbamates                    |
| • Benzimidazoles, Phenylpyrroles                    | • Fatty Acids                         |
| • Benzonitriles, Nitriles                           | • Halogenated Hydrocarbons            |
| • Carbamates  | • Hydrocarbons                        |
|   | • Indanediones                        |

- Inorganic Coppers
- Inorganic Zincs
- Inorganics, Other
- Microbials (Other than Bt)
- Miscellaneous (Non-classified)
- Nitro Derivatives
- Oils, Mineral and Vegetable
- Organic Acids
- Organochlorines
- Organometallics
- Organophosphorous
- Phenols
- Phenoxy Acids
- Phosphonic Acids, Phosphinic Acids
- Phthalic Acids
- Pyrethroids, Pyrethrins
- Pyridines
- Sulfonylureas, Uracils
- Thiocarbamates
- Triazines, Triazinones, Tetrazines
- Urea Derivatives

### **2.5.3 Sector of Use**

The intent of categorizing the sales by sector of use was to attempt to differentiate between various sectors and their relative usage of pesticides in Alberta. Initially, it was thought that the sales could be differentiated by product and by the vendor. For products such as home and garden pesticides (Domestic sector), and products used on livestock (Livestock sector), this was relatively easy. However, the sales records indicated that several of the vendors who sell agricultural products primarily, also sold herbicides that were primarily for turf, non-cropland, right of way (ROW) or landscape usage (Commercial/Industrial), and would not be used for agricultural production purposes, except perhaps for pasture renovation. These records were categorized as Commercial/Industrial.

Some products have multiple sectoral uses such as agriculture, landscaping or ROW maintenance. As the end use for these products could not be distinguished, these purchases at agricultural vendors have been included under the Agricultural sector. The resulting breakdowns therefore, are simplified and may not accurately reflect actual sectoral usage in Alberta. Some general guidance on sectoral usage was provided by the Alberta Agriculture Blue Book (AAFRD 2003a).

The sectors of use used in this report include:

- Agricultural (products sold at agricultural outlets and that had registrations for on-farm use)
- Domestic (products shipped to or sold at garden centres, hardware stores, etc)
- Commercial/Industrial (includes forestry, ROW, landscaping, golf courses, municipal)
- Livestock (products sold for use on cattle, horses, sheep, etc)
- Structural (products sold for use by exterminators).

## **2.5.4 Geographic Units**

### **2.5.4.1 River Basins**

There are 13 major river basins that are identified in Alberta. Within these river basins are numerous sub-basins or drainage basins, which define the watersheds of major and minor tributaries. In order to assist the interpretation of pesticide monitoring data for Alberta, which is generally reported by major river basin, and sometimes by sub-basin, identification of overall pesticide usage by river basin was required. All of the municipalities in the City database were identified as to their respective sub-basin. The major river basins in Alberta used for this report are based upon PFRA basins, obtained from Alberta Agriculture and Food (Spiess 2005):

- Athabasca River
- Battle River
- Beaver River
- Bow River
- Hay River
- Milk River
- North Saskatchewan River
- Oldman River
- Peace River
- Red Deer River
- Sounding Creek
- South Saskatchewan River

### **2.5.4.2 Natural Regions**

There are six major natural regions in Alberta, which contain a total of 21 subregions. To link pesticide sales to the various natural regions in Alberta, each municipality in the City database was allocated to an ecodistrict, which was then linked to the respective natural region in the Natural Region database. The detailed maps used to determine municipality location in relation to ecodistrict were obtained from AAFRD (2003b) and Strong and Thompson (1995). The natural regions identify different ecological zones within Alberta, which are influenced by soil type, climate, physiography, water, fauna, land use, and vegetative cover (ESWG 1995). The natural regions of Alberta (updated in 2005) are:

- Grassland
- Parkland
- Canadian Shield
- Foothills
- Rocky Mountain
- Boreal Forest

### **2.5.4.3 Municipalities**

There are about 88 municipalities (rural municipalities, cities and national parks) in Alberta. Pesticide sales were allocated to the municipality in which the vendor was located for data analysis by geo-political boundaries. In most situations, agricultural sales made at a vendor

located in a city were consolidated to the surrounding rural municipality (e.g., Camrose) for the purposes of sub-regional assessments and mapping purposes.

## **2.6 Use Intensity**

Pesticide use intensity, (kg of active ingredient used per hectare of land) is relatively inexact measurement, but it is often used to compare relative pesticide use between regions or countries with different land areas, or areas with different pesticide usage as a result of different crops requiring different pesticide inputs. It can also be used as a measure of relative pesticide use over time. In this report, pesticide sales by defined geographic area were considered representative of use, and the use intensity was calculated based on the land base for the defined geographic area.

### 3.0 RESULTS

In 2003, a total of 9 264 487.7 kg of active ingredient was sold in Alberta. The sales data are broken down as follows.

#### 3.1 Type of Use

Herbicides and plant growth regulators (PGR's) made up the majority of pesticides sold in Alberta, at 77.3% (Table 1). Although insecticides made up a greater proportion than fungicide sales in 2003, this was primarily attributed to an extensive grasshopper outbreak, which resulted in over 3.7 M acres being sprayed throughout Alberta (Ball 2006). In non-outbreak years, fungicide sales would likely exceed insecticide sales by volume.

**Table 1. Pesticide Sales by Type of Use**

Type of Use	Kg ai	Percentage (%)
Herbicides, PGR's	7 158 660.3	77.3
Insecticides, Acaracides, Repellents	433 176.1	4.7
Fungicides	319 464.5	3.4
Vertebrate Control Products and Vertebrate Repellents	1 712.9	0.02
Adjuvants and Surfactants	1 350 159.8	14.6
Other	1 313.9	0.01
<b>Totals</b>	<b>9 264 487.7</b>	<b>100</b>

Vertebrate control products and repellents made up a very small percentage of pesticide sales, at less than 0.02%. The majority of this was for products used for controlling Richardson's ground squirrel and pocket gophers.

Adjuvants and surfactants made up the second largest group, in terms of percentage of sales. These compounds are often packaged with herbicides, and are used to enhance the effectiveness of the herbicides on the target weed(s). Although they have been categorized as a separate type of use, because they are virtually always used in conjunction with a herbicide, they could be considered a component of the Herbicide group. Changes in packaging have been implemented, where adjuvants are no longer packaged with the herbicide, and future sales reporting may not capture the complete sales records for adjuvants. On the other hand, current sales records may overestimate actual adjuvant usage, as excess adjuvant can be returned to dealers through a CropLife Canada stewardship program for adjuvants in excess of producers needs.



The "Other" category includes sales for products that do not fit the named categories, and for which only a limited number of sales records were received. This category includes wood preservatives, disinfectants, slimicides and soil fumigants. As the disinfectants and slimicides are exempted under the provincial pesticide regulations, and the focus of the sales survey was primarily on the traditional pesticides, very little information on these products was obtained.

### 3.2 Chemical Group

The sales records were also broken down by chemical group (Table 2), as defined by the National Pesticide Sales Database groupings (Appendix 1). The chemical group with the largest proportion of sales was the Phosphonic Acids, Phosphinic Acids group at 38.1%, followed by the Phenoxy Acids at 21.1%. The next groups were the Hydrocarbons, and Oils, Mineral and Vegetable in the 6-7% range. These five groups consist of the major herbicides (and adjuvants/surfactants) used in Alberta. The remaining chemical groups were all under 5%, and 27 of the 42 chemical groups were under 1% of total sales.

**Table 2. Summary of Pesticide Sales by Chemical Group (all sectors)**

Chemical Grouping	Kg ai	Percentage %
Phosphonic Acids, Phosphinic Acids	3 529 524.0	38.1
Phenoxy Acids	1 957 477.2	21.1
Oils, Mineral and Vegetable	661 102.1	7.1
Hydrocarbons	560 461.0	6.0
Benzonitriles, Nitriles	398 799.9	4.3
Carboxylic Acids	377 602.0	4.1
Organophosphorus	270 235.3	2.9
Thiocarbamates	209 626.2	2.3
Nitro Derivatives	209 618.1	2.3
Cyclohexanedione oximes	175 914.1	1.9
Aryloxyphenoxyl Acids	124 762.3	1.3
Carbamates	106 395.8	1.1
Dicarboximides, Oxathiin	90 752.2	1.0
Inorganics, Other	81 895.0	0.9
Dithiocarbamates	72 063.7	0.8
Alcohols	66 481.2	0.7
Azoles, Diazaes, Oxazoles, Thiazoles, Triazoles	65 400.2	0.7
Pyridines	43 200.0	0.5
Miscellaneous (Non-classified)	41 613.5	0.4
Urea Derivatives	40 178.6	0.4
Amides, Anilines	37 264.3	0.4
Ammoniums, Quaternary	32 000.5	0.3
Benzimidazoles, Phenylpyrroles	29 496.2	0.3
Sulfonylureas, Uracils	21 611.9	0.2
Organochlorines	17 532.1	0.2



Triazines, Triazinones, Tetrazines	13 703.2	0.1
Pyrethroids, Pyrethrins	8 892.1	0.1
Inorganic Coppers	8 397.3	0.1
Diazines, Quinoxalines, Morpholines	6 504.9	0.1
Fatty Acids	2 432.8	0.0
Amino Acids	2 175.6	0.0
Phthalic Acids	572.5	0.0
Inorganic Zincs	458.9	0.0
Organic Acids	119.9	0.0
<i>Bacillus thuringiensis</i> species	70.2	0.0
Chromenones	64.9	0.0
Phenols	58.1	0.0
Organometallics	27.5	0.0
Indanediones	2.1	0.0
<b>Total</b>	<b>9 264 487.7</b>	<b>100.0</b>

### 3.3 Sector of Use

Pesticide sales broken down by sector of use are listed in Table 3. As expected, agricultural use dominates pesticide sales in Alberta at 96.2%. The next sector was the Commercial/Industrial sector at 3.1%. Domestic pesticide sales made up only 0.6% of total sales by active ingredient. Livestock and Structural sectors combined made up less than 0.1% of all sales.

Further breakdown of the sector sales by type of use was conducted to assess if the overall trends in type of use was consistent within each sector. Figures 1-3 show the breakdowns for each sector.

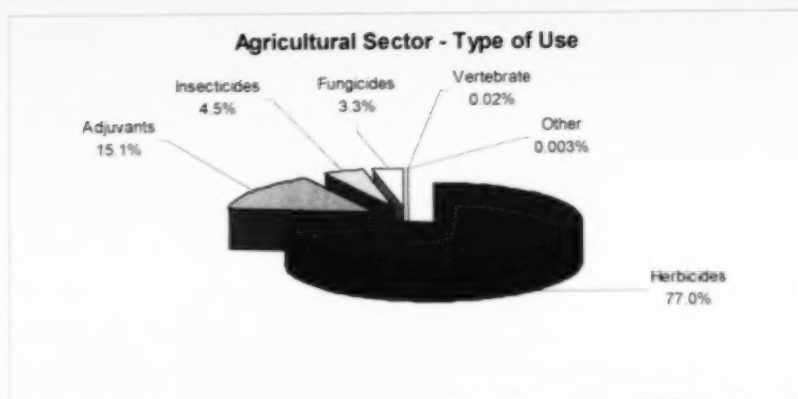
**Table 3. Pesticide Sales by Sector**

<b>Sector</b>	<b>Kg ai</b>	<b>Percentage (%)</b>
Agriculture	8 909 907.7	96.2
Commercial/Industrial	290 335.6	3.1
Domestic	58 711.7	0.6
Livestock	2 658.6	0.03
Structural	2 874.1	0.03
<b>Totals</b>	<b>9 264 487.7</b>	<b>100</b>

#### 3.3.1 Agricultural Sector

Herbicides made up the majority of pesticide use in the agricultural sector, with 77% of all sales. Adjuvants were the next highest category, at over 15% of pesticide use. As discussed earlier, adjuvants and surfactants are widely used to enhance the application and effectiveness of herbicides, and are often supplied by the manufacturer to be used in conjunction with their

products. Insecticide and fungicide use were each below 5% of agricultural pesticide sales in Alberta.



**Figure 1. Agriculture Sector – Type of Use**

The top 15 active ingredients sold in the agricultural market in Alberta in 2003 are listed in Table 4, with comparisons to the agricultural sales of those active ingredients in 1998. Overall, there was little change in the top selling products, although some changes were observed as a result of changes in agronomic practices or product replacements. Substantial increases (>20%) were observed for glyphosate, MCPA, bromoxynil, glufosinate, and petroleum hydrocarbon blend used as an adjuvant. The sales of carbaryl increased significantly, mainly as a result of other grasshopper control products being taken off the market (e.g., carbofuran, trichlorfon), and the grasshopper problems experienced in 2003 throughout Alberta.

Substantial reductions in sales were observed for triallate and ethalfluralin, both of which are pre-emergent herbicides used for wild oat control. This is indicative of a change in agronomic practices, moving towards zero tillage (both products require incorporation after application), and a move towards herbicide tolerant canola systems, which utilize products such as glyphosate for broad spectrum weed control.

**Table 4. Top 15 Agricultural Active Ingredient Sales for 2003 and 1998**

Active Ingredient	Usage	2003 Sales (kg ai)	1998 Sales (kg ai)	% Change (1998 to 2003)
Glyphosate	Herbicide	3 333 994.5	2 627 599.3	+26.9%
MCPA	Herbicide	1 096 848.9	884 937.5	+23.9%
2,4-D	Herbicide	685 294.5	674 902.6	+1.5%
Petroleum Hydrocarbon Blend	Adjuvant	559 728.7	368 704.3	+51.8%
Surfactant Blend	Adjuvant	437 400.5	496 177.7	-11.8%
Bromoxynil	Herbicide	354 906.6	268 105.3	+32.4%
Triallate	Herbicide	197 221.4	693 269.3	-71.6%
Chlorpyrifos	Insecticide	197 004.7	215 779.6	-8.7%
Paraffin Base Mineral Oil	Adjuvant	192 634.4	192 708.2	0.0%
Ethalfuralin	Herbicide	168 135.0	452 294.4	-62.8%
Tralkoxydim	Herbicide	141 226.1	126 323.5	+11.8%
Imazamethabenz	Herbicide	138 551.4	173 679.2	-20.2%
Dicamba	Herbicide	108 637.8	118 739.8	-8.5%
Glufosinate	Herbicide	106 689.6	63 400.8	+68.3%
Carbaryl	Insecticide	100 955.7	1 259.2	+7917.4%

In order to better compare the sector sales to 1998 Alberta sales, the chemical group breakdown was conducted on the agricultural pesticide sales (Table 5). The Phosphonic/Phosphinic Acids group dominated the agricultural sales at over 38%, which was an increase over 1998. The Phenoxy Acids group followed this at almost 21%, also increasing over 1998. The Mineral and Vegetable Oils and Carboxylic Acids were next at slightly over 7% of agricultural sales. Substantial changes in sales from 1998 were the over 5% reduction in Thiocarbamates and Nitro Derivatives (primarily triallate and trifluralin sales). Although it does not make up a large proportion overall, the reduction in organochlorine sales (primarily lindane) from over 57,000 kg to just slightly over 10,000 kg is a significant reduction of sales in this chemical group.

**Table 5. Summary of Agricultural Pesticide Sales by Chemical Group**

Chemical Group	2003		1998	
	Kg ai	%	Kg ai	%
Phosphonic Acids, Phosphinic Acids	3 442 310.0	38.6	2 726 841.7	30.6
Phenoxy Acids	1 859 658.2	20.9	1 628 866.2	18.3
Oils, Mineral and Vegetable	657 993.3	7.4	767 002.9	8.6
Hydrocarbons	559 728.7	6.3	368 704.3	4.1
Benzonitriles, Nitriles	394 253.6	4.4	298 994.6	3.3
Carboxylic Acids	318 789.7	3.6	365 508.6	4.1
Organophosphorus	259 892.5	2.9	263 784.0	3.0
Thiocarbamates	209 626.2	2.4	734 218.3	8.2
Nitro Derivatives	209 618.1	2.4	682 990.7	7.7
Cyclohexanedione oximes	175 914.1	2.0	187 367.4	2.1
Aryloxyphenoxy Acids	124 761.9	1.4	136 306.8	1.5
Carbamates	102 450.5	1.1	10 076.4	0.1
Dicarboximides, Oxathiin	87 715.7	1.0	152 440.3	1.7

Inorganics, Other	70 452.9	0.8	135 613.5	1.5
Dithiocarbamates	69 281.6	0.8	94 743.2	1.1
Azoles, Diazoles, Oxazoles, Thiazoles, Triazoles	64 783.5	0.7	20 110.0	0.2
Alcohols	64 641.4	0.7	103 151.9	1.2
Pyridines	43 166.7	0.5	23 695.6	0.3
Amides, Anilines	33 671.3	0.4	10 111.2	0.1
Ammoniums, Quaternary	31 241.3	0.4	36 043.9	0.4
Benzimidazoles, Phenylpyrroles	29 027.5	0.3	18 169.0	0.2
Miscellaneous (Non-classified)	22 478.2	0.3	22 112.0	0.3
Sulfonylureas, Uracils	18 400.1	0.2	28 776.8	0.3
Triazines, Triazinones, Tetrazines	12 963.2	0.1	19 098.3	0.2
Urea Derivatives	11 188.6	0.1	9 015.0	0.1
Organochlorines	10 130.5	0.1	57 159.3	0.6
Pyrethroids, Pyrethrins	8 239.6	0.1	2 497.6	0.03
Inorganic Coppers	8 052.8	0.1	277.7	0.003
Diazines, Quinoxalines, Morpholines	6 364.3	0.1	3 774.9	0.04
Amino Acids	2 120.2	0.02	1 091.5	0.01
Inorganic Zincs	435.3	0.005	44.5	0.0005
Fatty Acids	319.2	0.004	4 684.6	0.05
Phthalic Acids	211.6	0.002	696.3	0.01
<i>Bacillus thuringiensis</i> species	23.7	0.0003	0	0.00
Indanediones	1.1	0.000	1.5	0.00
Chromenones	0.6	0.000	7.4	0.00
Organometallics	0	0.0	3.8	0.00
Organic Acids	0	0.0	0.014	0.00
<b>Totals</b>	<b>8 909 907.7</b>	<b>100</b>	<b>8 913 981.7</b>	<b>100</b>

### 3.3.2 Domestic Sector

In the domestic sector (Figure 2), herbicides again dominated at just over 60%, however insecticide sales made up a significant proportion of pesticide sales at over 35%. Fungicide sales were proportionately similar to agricultural fungicide sales, at around 3-4%.

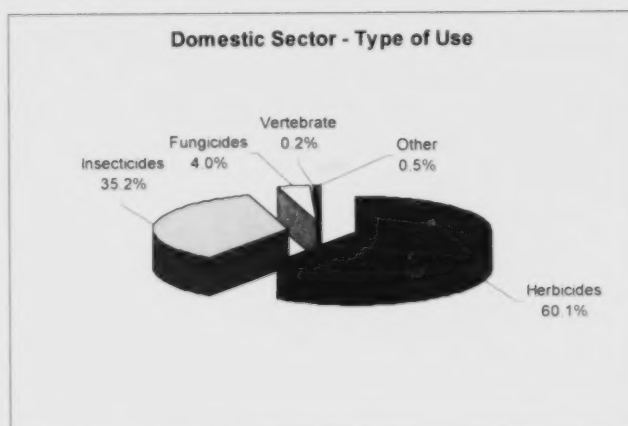


Figure 2. Domestic Sector – Type of Use

As with the agricultural products, the domestic product sales were also broken down by chemical group (Table 6). In the Domestic sector, the Phenoxy Acids dominated at about 35% of total pesticide sales, followed by Phosphonic/Phosphinic Acids and Inorganics. The Phenoxy Acids made up a smaller proportion of sales in 2003 compared to 1998, while the Phosphonic/Phosphinic Acids and Inorganic Acids increased over 1998, almost doubling in proportion of sales.

**Table 6. Summary of Domestic Pesticide Sales by Chemical Group**

Chemical Group	2003		1998	
	Kg ai	%	Kg ai	%
Phenoxy Acids	20 666.3	35.2	32 548.9	44.7
Phosphonic Acids, Phosphinic Acids	11 012.9	18.8	6 929.9	9.5
Inorganics, Other	10 416.1	17.7	7 504.9	10.3
Organophosphorus	3 672.5	6.3	7 425.5	10.2
Amides, Anilines	3 413.3	5.8	3 972.2	5.5
Carbamates	3 265.2	5.6	1 457.6	2.0
Miscellaneous (Non-classified)	1 539.3	2.6	856.9	1.2
Fatty Acids	893.1	1.5	1 231.6	1.7
Oils, Mineral and Vegetable	878.9	1.5	3 005.9	4.1
Hydrocarbons	729.5	1.3	2 782.3	3.8
Carboxylic Acids	453.4	0.8	716.1	1.0
Pyrethroids, Pyrethrins	386.6	0.7	128.3	0.2
Phthalic Acids	313.3	0.5	206.8	0.3
Triazines, Triazinones, Tetrazines	291.0	0.5	647.9	0.9
Dithiocarbamates	204.2	0.4	563.7	0.8
Alcohols	192.2	0.3	0.02	0.0
Inorganic Coppers	190.9	0.3	450.5	0.6
Chromenones	62.5	0.1	168.1	0.2
Phenols	58.1	0.1	805.2	1.1
Organochlorines	38.3	0.07	194.9	0.3
Diazines, Quinoxalines, Morpholines	12.2	0.02	12.7	0.02
Inorganic Zincs	9.8	0.02	40.0	0.06
<i>Bacillus thuringiensis</i> species	6.2	0.01	95.0*	0.1
Benzimidazoles, Phenylpyrroles	3.4	0.006	69.7	0.1
Azoles, Diazaes, Oxazoles, Thiazoles, Triazoles	1.96	0.003	34.1	0.05
Indanediones	0.3	0.001	0.3	0.00
Pyridines	0.045	0.000	6.3	0.01
Aryloxyphenoxyl Acids	0.015	0.000	0.02	0.00
Ammoniums, Quaternary	0.005	0.000	3.9	0.01
Amino Acids	0.003	0.000	0.014	0.00
Benzonitriles, Nitriles	0.0	-	147.6	0.2
Urea Derivatives	0.0	-	14.7	0.02
Sulfonylureas, Uracils	0.0	-	1.5	0.00
Nitro Derivatives	0.0	-	1.2	0.00
Organometallics	0.0	-	0.13	0.00
<b>Totals</b>	<b>58 711.7</b>	<b>100</b>	<b>72 024.4</b>	<b>100</b>

\* *Bacillus* active ingredient concentrations calculated differently in 1998 and 2003. See Section XXX.

It should be noted that there are some gaps in the domestic sales data, particularly in the herbicide sales, making direct comparisons between the two years difficult. The trends are illustrative however, particularly in the reduction of the Organophosphorus group, and increase in the Carbamates group, reflecting deregistration of the domestic organophosphate insecticides and partial substitution with carbamate insecticides.

The top domestic products sold in 2003 are listed in Table 7. Turf herbicides dominated (2,4-D and mecoprop), while glyphosate sales were also high. Glyphosate (and glufosinate) sales have increased as other total vegetation control products (atrazine, bromacil, etc) have been replaced. Silicon dioxide sales are also high in 2003, as products containing this active ingredient have been more widely utilized for insect control in indoor situations.

**Table 7. Top 15 Domestic Active Ingredient by Sales, 2003**

<b>Domestic active ingredient</b>	<b>Kg ai</b>
2,4-D	14 392.5
Glyphosate	10 448.5
Silicon dioxide salt water fossils	7509.2
Mecoprop	6273.8
DEET	3413.3
Carbaryl	3151.9
Malathion	1667.8
Ferrous sulfate	1593.4
Diazinon	1292.6
Acetic acid	1130.5
Mineral oil (Insecticidal or Adjuvant)	838.9
Soap (Insecticidal)	815.8
Sulphur (Fungicide)	722.8
Asphalt solids	591.9
Glufosinate	564.4

### **3.3.3 Commercial/Industrial Sector**

In the Commercial/Industrial Sector, herbicides again dominated at 90% of pesticide sales (Figure 3). Insecticides made up just over 2%. Fungicide sales were proportionately slightly higher in this sector, at over 6%, reflecting fungicide sales to the golf course industry. Table 8 provides a more detailed breakdown of the top 15 active ingredients that were classified as being sold and used in the commercial/industrial sectors, and reflects the dominance of products sold and used for industrial site and right-of-way maintenance.

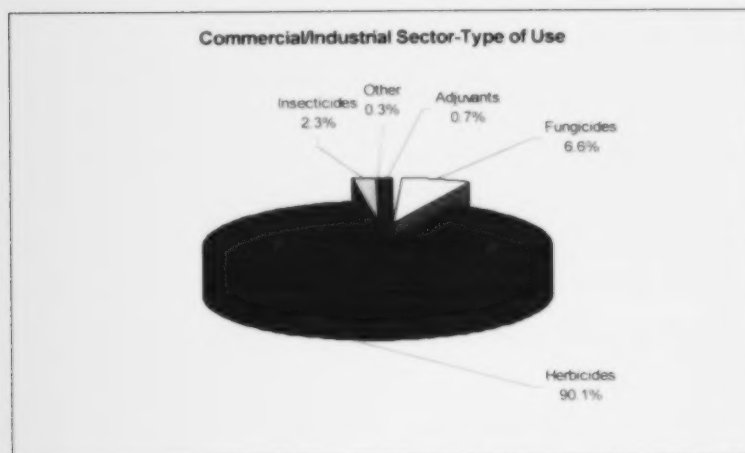


Figure 3. Commercial/Industrial Sector – Type of Use

Table 8. Top 15 Commercial/Industrial Active Ingredients sold in 2003

Commercial/Industrial Active Ingredient	Kg ai
Glyphosate	75 379.1
2,4-D	63 670.6
Triclopyr	29 625.6
Diuron	28 960.0
Acrolein	16 981.4
Picloram	13 302.3
Dicamba	12 344.2
Mecoprop	12 288.0
Quintozene	6 829.0
Chlorothalonil	4 363.5
Bromacil	3 051.6
Iprodione	2 109.9
Thiram	1 908.8
Imazapyr	1 675.8
Mineral oil (Insecticidal or Adjuvant)	1 394.8

### 3.3.4 Other Sectors

Pesticide sales in the Livestock sector consisted of primarily insecticides. The Structural sector also was dominated by insecticide sales, with a small quantity of vertebrate control products.



### **3.4 Geographic Distributions**

#### **3.4.1 Drainage Basin**

##### **3.4.1.1 Agricultural Usage**

Sales of all agricultural products (excluding adjuvants) were broken down by drainage basin (Table 9 and Figure 4). The Oldman River basin had the highest proportion of agricultural pesticide sales, at 21.4%, followed by the Red Deer River basin, the North Saskatchewan River basin, and the Battle River basin. The Peace River basin had just below 10% of total agricultural pesticide sales, while the remaining basins were all below 10%.

**Table 9. Agricultural Pesticide Sales (excluding adjuvants) by River Basin**

<b>River Basin</b>	<b>Kg ai</b>	<b>(%)</b>
Oldman River	1 615 182.5	21.4
Red Deer River	1 334 005.1	17.6
North Saskatchewan River	1 137 851.8	15.0
Battle River	1 108 136.4	14.6
Peace River	731 480.1	9.7
South Saskatchewan River	647 561.2	8.6
Bow River	536 221.4	7.1
Athabasca River	234 328.2	3.1
Sounding Creek	113 392.8	1.5
Beaver River	64 767.2	0.9
Milk River	34 858.4	0.5
Non-specific basin	4069.1	0.05
<b>Alberta</b>	<b>7 561 853.9</b>	<b>100</b>

##### **3.4.1.2 Total Pesticide Usage**

Another factor that helps to relate the size and scale of drainage basins and pesticide use is river discharge and mean annual flows. A higher mean annual flow in relation to overall pesticide use would indicate greater potential for dilution and less potential for water quality guideline exceedences. Mean monthly discharges (over various reporting periods) were obtained from the Water Survey of Canada (2005), converted to mean annual flow with an Excel macro, and are listed in Table 10. The rivers with the highest mean annual flow have the greatest dilution capacity, and other things being equal, should have lower concentrations of pesticide residues. Also listed is the gross drainage area associated with the specific gauging station for each basin, and a calculated mean runoff value (runoff volume divided by drainage area)(Martin 2001). The mean annual runoff reflects the relative differences in precipitation, flow and basin size. For



example, the mean annual flow of 1780 dam<sup>3</sup> for Sounding Creek, spread equally over the 2986 km<sup>2</sup>, works out to 0.6 mm of water, which is comparable to a very light rainfall, and virtually no runoff from the landscape. On the other hand, the 221.3 mm of calculated runoff for the Peace River basin would suggest that there is high potential for runoff from the landscape, and subsequently mobilizing soil particles, pesticides, nutrients, and other compounds that can impact water quality in the basin. However, these are calculated values to illustrate relative differences between basins, and do not reflect on large storm runoff events, which can make up a substantial portion of the water borne contaminants moved from the landscape to the water bodies.

The highest pesticide use intensity is found in the Sounding Creek basin, one of the smallest basins in Alberta. However, this is a very dry area of the province, and Sounding Creek has only intermittent flow throughout the year, because of the low precipitation in this basin (321.5 mm/year at Oyen -1971-2000 annual average). As well, this stream originates in the prairies, and does not have the higher elevation headwaters that provide much of the base flow for the other river basins in Alberta.

**Table 10. Total Pesticide Sales by River Basin – Flow**

River Basin (gauging station used)	Kg ai	Mean Annual Flow Volume (dam <sup>3</sup> )	Kg/dam <sup>3</sup>	Gross Drainage, by station (km <sup>2</sup> )	Mean Annual Runoff (mm)
Milk River (Int. Border – East crossing)	41 913.2	311 000	0.135	6 490	48
South Saskatchewan River (Hwy 41)	787 052.5	5 180 000	0.152	71 145	72.8
Oldman River (at mouth)	1 920 942.9	2 180 000	0.881	27 504	79.2
Bow River (near mouth)	650 317.2	2 760 000	0.235	25 303	108.9
Red Deer River (at Empress)	1 552 223.6	1 760 000	0.882	44 700	39.4
Sounding Creek (at Oyen)	128 877.4	1 780	72.403	2 986	0.6
Battle River (near Sask. border)	1 312 404.8	194 000	6.765	25 077	7.8
North Saskatchewan River (Lea Park)	1 362 779.6	6 810 000	0.200	47 756	119.3
Beaver River (Cold Lake Reserve)	70 728.4	597 000	0.118	14 511	41.2
Athabasca River (below Ft. McMurray)	304 878.8	19 900 000	0.015	132 622	150.4
Peace River (Peace Point)	918 463.9	66 500 000	0.014	300 337	221.3
Hay River (near Meander River)	0.45	2 240 000	---	36 903	60.7
Non-specific basin	213 905.0	N/A	N/A	N/A	N/A
<b>Alberta</b>	<b>9 264 487.7</b>				

Dam<sup>3</sup> = cubic decametre = 1 000 m<sup>3</sup>

The next highest basin in relation to pesticide usage and average annual flow is the Battle River basin, at 6.76 kg/dam<sup>3</sup>. This basin is adjacent to the Sounding Creek basin, and also flows through the southern and eastern portion of the Central Parkland and Dry Mixedgrass regions of

the province. This basin also originates on the prairies at Battle Lake, and is dependent upon local snowfall and summer precipitation for primary inputs to the basin.

The other basins are all below 1 kg/dam<sup>3</sup>, which are reflective of their higher annual flows. Most of these basins (the exception being the Beaver River) originate in the foothills or the Rocky Mountains, in whole or in part. The mainstems or tributaries that originate at higher elevations usually supply a major proportion of the base flow for these basins.

### 3.4.2 Pesticide Sales by Natural Region

Pesticide sales were also broken down by natural region (Figure 5) to assess pesticide sales/usage in relation to the natural regions in Alberta, which represent areas of comparable soils, climate and vegetation (Table 11). This information is of interest in relation to cropping practices that are often comparable within these regions.

Pesticide sales were concentrated in four natural regions in Alberta. The largest amount of pesticide sold, at over 35% of provincial sales, was the Central Parkland region. The Dry Mixedgrass region was next at 19.8 %, followed by the Mixedgrass region at 15.3%, and the Dry Mixedwood region at 12.2%.

**Table 11. Pesticide Sales by Natural Region**

Natural Region	Sub Region	Kg ai	%
<b>Alberta (non-specific region)</b>		<b>213 905.0</b>	<b>2.3</b>
Boreal	Central Mixedwood	31 486.3	0.3
	Dry Mixedwood	1 126 572.7	12.2
	Lower Boreal Highlands	0.5	0.0
<b>Boreal Total</b>		<b>1 158 059.5</b>	<b>12.5</b>
Foothills	Lower Foothills	10 557.4	0.1
	Upper Foothills	29.1	0.0
<b>Foothills Total</b>		<b>10 586.5</b>	<b>0.1</b>
Grassland	Dry Mixedgrass	1 831 323.8	19.8
	Foothills Fescue	711 924.8	7.7
	Mixedgrass	1 414 122.2	15.3
	Northern Fescue	328 584.0	3.5
<b>Grassland Total</b>		<b>4 285 954.8</b>	<b>46.3</b>
Parkland	Central Parkland	3 258 822.0	35.2
	Foothills Parkland	2 113.7	0.0
	Peace River Parkland	334 291.9	3.6
<b>Parkland Total</b>		<b>3 595 227.6</b>	<b>38.8</b>
<b>Rocky Mountain</b>	<b>Montane</b>	<b>754.3</b>	<b>0.0</b>
<b>Total</b>		<b>9 264 487.7</b>	<b>100.0</b>

### 3.4.3 Pesticide Sales by Municipality

Pesticide sales were broken out by rural municipality to provide a detailed geo-administrative overview of sales, using municipal boundaries that are familiar to many individuals and various levels of government. The largest volume of sales (agricultural products excluding adjuvants) occurred in the County of Lethbridge and the MD of Taber (>500,000 kg ai), which are major supply and distribution centres for southern Alberta, particularly the irrigated region of Alberta. Municipalities with greater than 300 000 kg ai of sales were the Counties of Cypress, Forty Mile, Kneehill, Vulcan, and Vermilion River. These are large municipalities with the highest proportion of total crop area in Alberta (AAFRD 2002). Data on primary crops grown in 2001 in the six municipalities with highest sales was derived from AAFRD (2002)(Table 12).

**Table 12. Breakdown by Municipality of 2001 Crop (ha), Agricultural Pesticide Sales (2003 kg ai), and Use Intensity (kg ai/ha)**

Crop Group	Lethbridge	Taber	Kneehill	Forty Mile	Vermilion River
Cereals (Wheat, oats, barley, etc)	149 430	116 728	170 798	202 576	169 910
Oilseeds (Canola, flaxseed, mustard)	9 195	6 576	24 511	4 159	59 633
Other Field Crops (Potatoes, Peas, Sugar Beets, etc)	14 432	44 901	15 943	31 358	18 834
Vegetables (Sweet corn)	421	3172	11	5	27
Hay and Forage	35 356	26 587	14 872	12 854	37 598
Total Hectares in Crop Land (2001)	208 834	197 964	226 135	250 682	286 002
Agric. Sales (kg ai) (excl. adjuvant)	544 549.0	511 990.1	338 871.2	329 666.2	318 933.7
<b>Use Intensity (kg/ha)</b>					
<b>2003</b>	<b>2.61</b>	<b>2.59</b>	<b>1.50</b>	<b>1.31</b>	<b>1.11</b>

Acreages for major crop groups varied among municipality, however cereals (primarily wheat) dominated in each municipality. Oilseeds (primarily canola) had relatively high acreage in Vermilion River and Kneehill, but relatively low acreage in Taber and Lethbridge. Potatoes and sugar beets accounted for most of the Other Field Crops grown in Taber and Lethbridge, while field peas and dry beans were extensively grown in the other municipalities. Vegetable production was predominately in the irrigated municipalities of Taber and Lethbridge. The range

of crop types in various municipalities influences the type of pesticides used, as well as the use intensity (rate and frequency of application). Potatoes and sugar beets use very different products than cereals and oilseeds, and pesticide use is often more intensive on these types of crops for disease suppression, weed control and insect control. This is reflected in the use intensities for Taber and Lethbridge, which are relatively high at over 2.5 kg/ha. These municipalities may also serve as regional supply centres, so the use intensities for these two may be a slight overestimation.

Total sales (all sectors and all products) for all of the municipalities in Alberta are summarized in Table 13.

**Table 13. Total Pesticide Sales by Municipality (2003)**

Municipality	Kg ai	Municipality	Kg ai	Municipality	Kg ai
Lethbridge	660 379.7	Ponoka	124 422.9	Lacombe	44 670.9
Taber	598 434.0	Fairview	119 651.5	Acadia	42 785.2
Forty Mile	417 479.1	Strathcona	119 082.3	City of Calgary	38 858.8
Kneehill	406 928.1	Stettler	115 194.3	Big Lakes	38 332.3
Vermilion River	383 559.5	Sturgeon	114 246.5	Athabasca	38 268.8
Cypress	343 612.5	Drumheller	108 843.3	Lac Ste. Anne	30 013.2
Wheatland	341 133.5	Provost	107 148.9	Special Area 2	28 812.6
Vulcan	316 864.4	Spirit River	105 029.7	Woodlands	22 658.2
Flagstaff	289 797.1	Warner	98 277.6	Clear Hills	22 342.6
Camrose	276 414.7	Two Hills	91 165.0	Thorhild	21 187.5
Rocky View	235 823.0	Leduc	85 827.5	City of Edmonton	12 724.7
Alberta (non-specific)	213 905.0	Starland	85 809.3	Saddle Hills	10 169.8
Red Deer	188 944.4	Wetaskiwin	84 413.2	Greenview	8 530.6
Grande Prairie	188 080.0	Paintearth	72 809.5	Lesser Slave River	4 325.6
Minburn	182 530.3	Northern Lights	72 407.3	Clearwater	2 896.7
Beaver	181 192.2	Mackenzie	71 509.1	Opportunity	1 934.1
Willow Creek	181 143.9	Parkland	67 481.5	Yellowhead	666.4
Newell	169 869.6	Birch Hills	67 222.1	Lakeland	428.5
Foothills	156 080.5	Northern Sunrise	65 894.4	Wood Buffalo	397.8
Special Area 3	153 703.8	St. Paul	65 886.9	Brazeau	267.7
Lamont	151 114.8	Barrhead	61 114.0	Ranchland	247.6
Wainwright	145 214.0	Special Area 4	60 975.0	Bighorn	137.7
Mountain View	144 397.3	Bonnyville	56 517.4	Jasper Nat. Park	130.5
Smoky River	133 701.0	Peace	51 992.2	Banff Nat. Park	10.1
Westlock	132 220.1	Smoky Lake	51 740.8	Elk Island Nat. Park	1.2
Cardston	129 603.7	Pincher Creek	46 900.3		
				<b>Total</b>	<b>9 264 487.7</b>

In 1998, there were several municipalities that did not have any sales associated with them, as there were no vendors in those municipalities, even though there were agricultural operations in the municipality. Since then, vendors have set up retail outlets in those municipalities, and a slightly more representative distribution of sales (at least for the agricultural sector) was observed for 2003. Pesticides sold in the National Parks were primarily lawn and garden products. A graphical depiction of pesticide sales with municipal boundaries is given in Figure 6.



Figure 4. Total Agricultural Pesticide Sales (including adulterants) (kg/ha) (2001)



Figure 5. Total Pesticide Sales by Natural Region and Subregion - 2003

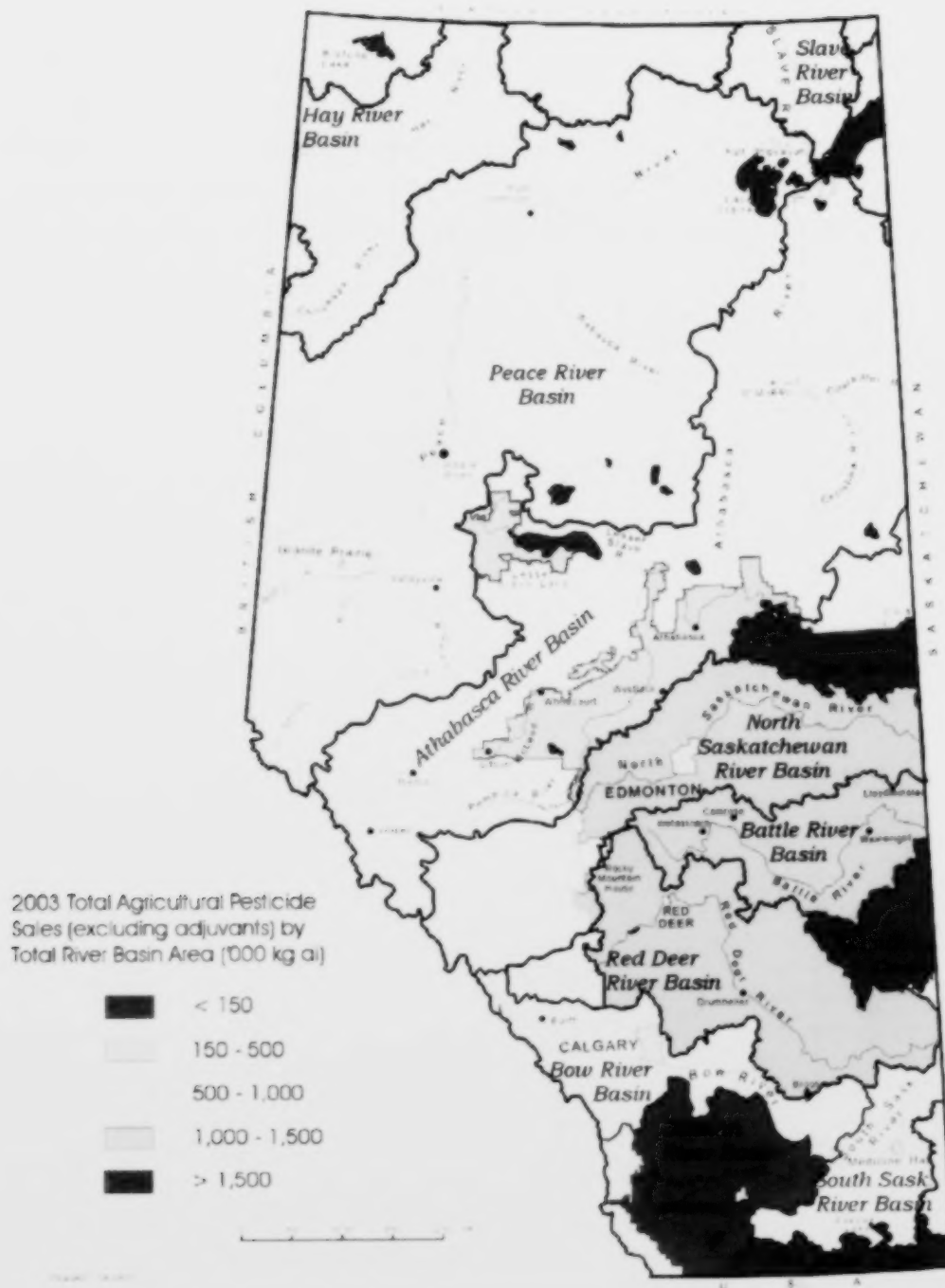


Figure 4. Total Agricultural Pesticide Sales (excluding adjuvants) By River Basin ('000 kg ai) - 2003



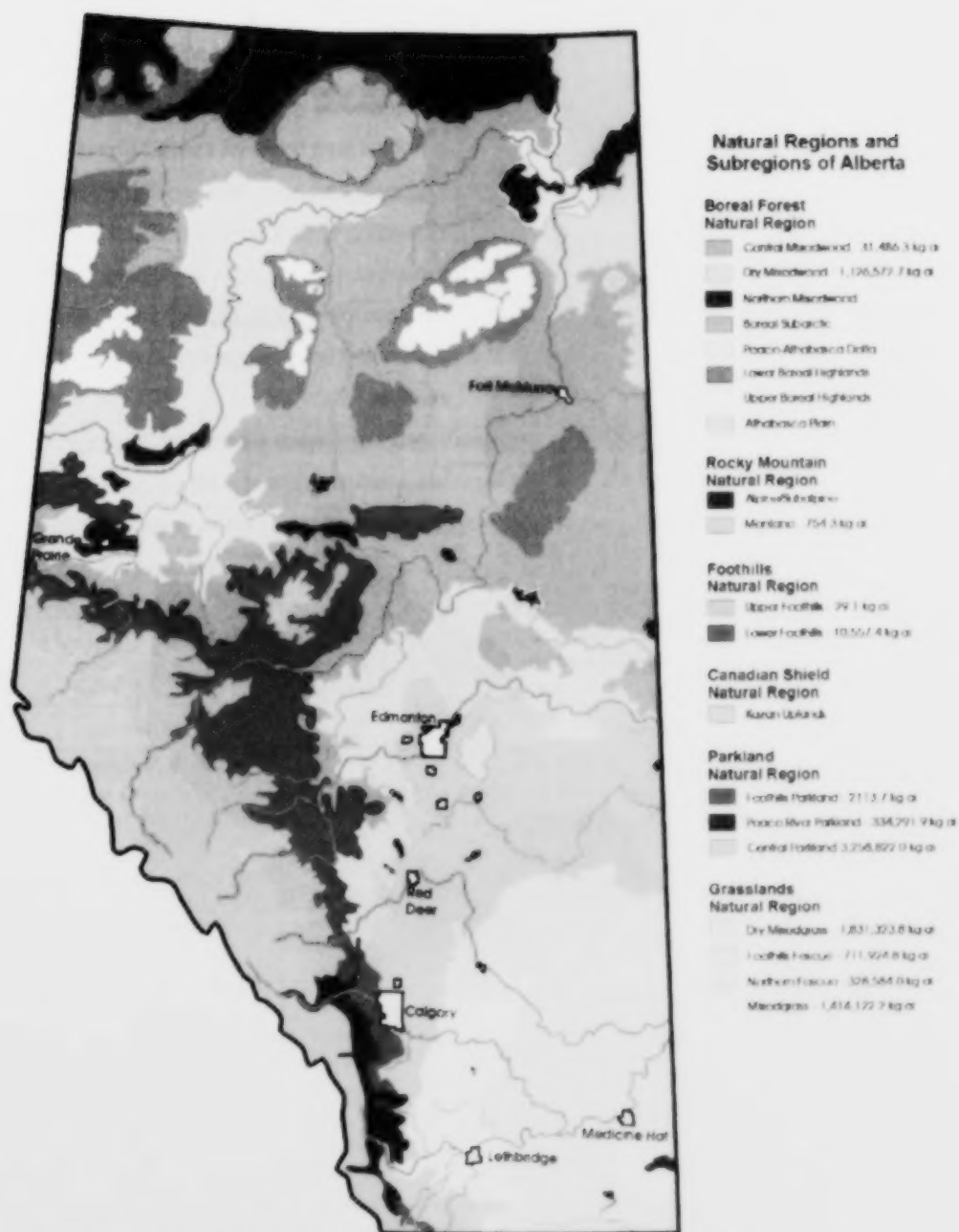


Figure 5. Total Pesticide Sales by Natural Region and Subregion – 2003





## 4.0 DISCUSSION

### 4.1 Use Intensity-Alberta

The first pesticide sales survey was conducted in Alberta for 1988 to 1993 for agricultural products only; it was followed by a comprehensive multi-sector survey in 1998 and again in 2003. The 1988 to 1993 sales data were based upon data obtained from the major line companies operating in Alberta at the time (e.g., grain handling companies). It did not include the sales data from independent dealers, which was estimated to make up approximately half of the market at the time, so the values listed are the reported sales doubled. The 1998 and 2003 surveys includes data from the line companies and independent dealers, and are much more comprehensive.

Total agricultural sales for those years were determined, and correlated to cropland information obtained from the Census of Agriculture, also carried out every 5 years (Pekalski 1995, AAFRD 2002). The timing of the Census of Agriculture (years ending in 1 and 6) and the pesticide sales survey (years ending in 3 and 8) do not match, but the closest time periods are used for comparing and calculating overall agricultural pesticide use intensity for Alberta.

**Table 14. Pesticide use comparisons 1988-2003 (excluding adjuvants)**

	<b>1988</b>	<b>1993</b>	<b>1998</b>	<b>2003</b>
<b>Ag Pesticide Sales (kg ai)</b>	6 956 950	7 491 440	7 588 662	7 561 854
<b>Cropland area (ha)(census survey year in brackets)</b>	9 162 850 (1986)	9 292 374 (1991)	9,546,886 (1996)	9 728 527 (2001)
<b>Pesticide use intensity (kg/ha)</b>	0.76	0.81	0.79	0.78

Overall agricultural pesticide use intensity has not changed much in Alberta over the past 15 years. There has been a slight increase in overall pesticide sales, but the calculated pesticide use intensity tends to remain near 0.8 kg/ha.

More detailed breakdown of pesticide sales by municipality (Figure 6) and calculated use intensity (Table 12) shows that high sales areas correspond to high use areas because of cropping practices in the area. For example, higher regional pesticide use intensity occurs in municipalities where irrigation farming is important, and where crop production and crop inputs for crops such as potatoes, sugar beets, and corn are higher than most dryland agricultural areas of the province.

## 4.2 Pesticide Use – Other Regions

A recent report by Environment Canada surveyed the provinces to determine what information was available on pesticides through sales or use surveys (Brimble et al. 2005). Most provinces (except Saskatchewan) conduct sales or use surveys annually, or on regular basis. A synopsis of the pesticide sales/use by province is presented in Table 15.

Alberta reports the highest overall sales, although it is anticipated that Saskatchewan would be higher, if they had a reporting program. The Prairies, Ontario and Nova Scotia use predominately herbicides, while New Brunswick and P.E.I. reported using primarily fungicides (related to potato acreage). Newfoundland reported mainly insecticide use for biting fly control.

**Table 15. Pesticide use by product and type of use by province (excluding adjuvants)**

Province	Year	Total	Herbicide	Insecticide	Fungicide	Other	Comments
BC	2003	1 061 185	286 423	408 662	304 682	61 471	Ag/For/Comm*
Alberta	2003	7 561 854	6 861 274	400 451	298 362	1768	Ag only
Saskatchewan	--	--	--	--	--	--	No sales survey
Manitoba	2003	3 580 536	3 172 807	97 518	310 073	--	Based on Crop Insurance database-not sales
Ontario	2003	4 218 238	3 348 118	81 775	313 912	474 433	Ag use survey
Quebec	2001	2 291 716	--	--	--	--	No breakdown
Nova Scotia	2003	441 609	299 247	37 994	59 341	42 568	Ag/For/Comm
New Brunswick	2003	921 138	236 466	52 926	482 986	146 077	Ag/For/Comm
P.E.I.	2002	814 103	111 237	35 004	667 862	--	
Newfoundland	2003	42 400	4023	34 992	511	2944	

\*Ag/For/Comm – Agricultural/Forestry/Commercial

Data from the U.S. for 2001 showed that nationally, about 888 million pounds (403 million kg) of active ingredient was used in the agricultural, industrial/commercial, and home and garden sectors (EPA 2004). Agriculture made up 76% of the usage, compared to over 96% in Alberta. Of the total amount, 62.3% of active ingredient used was herbicides, compared to 78% in Alberta. These differences reflect the differences in crops, pests and crop protection inputs used in the U.S. as compared to Alberta, and should be considered during comparisons of the industries in the two jurisdictions.

### 4.3 Cropping Practices

Seeding of herbicide tolerant canola in Alberta has influenced pesticide use over the past 10 years. Prior to herbicide tolerant canola coming onto the market, multiple herbicide mixtures and applications were required to control various broadleaf and grassy weeds in canola. Herbicide tolerant canola has allowed full spectrum weed control with a single product or a mixture of two (primarily glyphosate, although glufosinate and the imidazolinones such as imazethapyr, imazamox, and imazapyr have found niches). Agricultural Financial Services Corporation (Alberta) collects some cropping information on canola varieties based on insurance records, which are estimated to cover about  $\frac{3}{4}$  of the total canola (*Brassica napus* and *B. rapa* varieties) seeded acreages (Hartman 2005).

In 1996, conventional canola accounted for 94% of total seeded canola acres (Figure 7). Two years later (1998), it accounted for only 41%, whereas by 2003 it accounted for only 10% of seeded acres. Glyphosate tolerant (Roundup Ready), glufosinate tolerant (Liberty Link) and imidazolinone tolerant (Clearfield) made up the rest. Total canola acreage harvested in Alberta fluctuates from year to year, from 2.5M acres to 4.5M acres (Table 16).

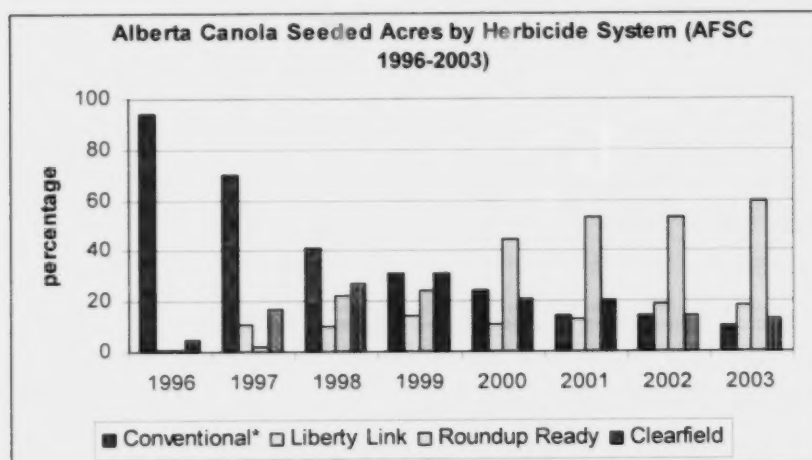
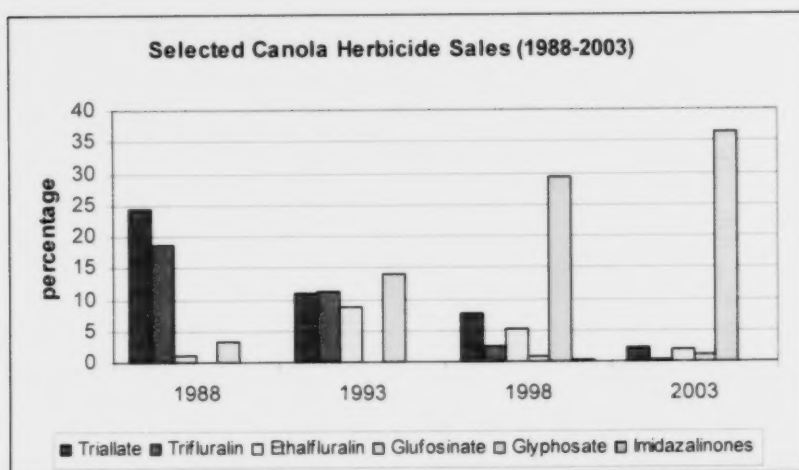


Figure 7. Alberta Canola Seeded Acres (1996-2003)

Table 16. Canola total acres harvested ('000's)(based on Canola Council 2005 data)

	1996	1997	1998	1999	2000	2001	2002	2003
Acres harvested ('000 acres)	3 000	3 950	4 300	4 520	3 700	2 670	2 500	3 300

Agricultural pesticide sales data reflect the changes in products used on herbicide tolerant canola (Figure 8). The Imidazolinones used on canola (e.g., imazamox and imazethapyr) was a relatively new product family in 1998, but sales had dropped by 2003, due to a reduction in Clearfield variety popularity and issues with residue carryover. Pre-emergent herbicides used primarily on canola, but also on other crops (i.e., triallate, ethalfluralin and trifluralin) have dropped significantly in sales volume over the past 15 years, while glyphosate has increased significantly each reporting period. All of the increase in glyphosate sales cannot be directly attributed to changes in canola cropping practices, as glyphosate sales were already increasing in 1993 before herbicide tolerant canola came onto the market. As producers adopted zero-tillage practices throughout the 1990's and early 2000's, the use of glyphosate for pre-seeding weed control instead of tillage has contributed to the increase in glyphosate sales. Additionally, some of the increase in glyphosate use can be attributed to other changes in farming practices such as 'chemical fallow', pre-harvest glyphosate applications, and applications after harvest.



**Figure 8. Selected Canola Herbicide Sales (1988-2003)**

#### **4.4 Agricultural Insecticides**

Agricultural insecticide use fluctuates considerably from year to year. In 2003, insecticides accounted for 4.5% of all agricultural use, and three-quarters of that consisted of two compounds: chlorpyrifos and carbaryl. Most of that usage was related to grasshopper spraying, as there was a considerable grasshopper outbreak that year. Over 3.7 M acres were sprayed in 2003 (based upon data from a financial assistance program by Alberta Agriculture and Food – Ball 2006). For comparison, approximately 663,000 acres were sprayed in 2005.

In 1998, high sales volumes of chlorpyrifos were also reported because of an outbreak of *Lygus* bug which required spraying of 1.4 M acres for this pest species (Byrtus 2000). Insecticide use in both years surveyed was influenced considerably by insect pest outbreaks.

#### **4.5 Spatial Data**

The pesticide sales data was sorted in a number of ways to provide some spatial perspective. The spatial sorts were done by municipality, by natural region. The municipality level was the highest level of resolution attempted, with over 60 polygons involved. Problems in interpreting data at this scale are that vendors are not evenly distributed amongst municipalities, with some major distribution centres (e.g., Lethbridge, Medicine Hat) influencing some of the spatial interpretation of the data.

##### **4.5.1 Linkage to Surface Water Monitoring Programs**

The original reason for reporting on pesticide sales was to document product use in Alberta to assist in establishing priorities for monitoring – by product and by area (Cotton and Byrtus 1995). Data from 1993, 1998 and this report have been used to assist in determining priorities for water quality guideline assessment, refine the list of compounds to be monitored, and relate observed detections directly to provincial and basin usage. For example, data from 1998 was used to assist in interpreting detections of pesticides in Alberta surface waters from 1995 to 2002 (Anderson 2005). Integrating monitoring and sales information can also assist in determining whether monitoring efforts in individual basins are in sync with relative pesticide sales. For example, a review of the sampling intensity by basin from 1995 to 2002 shows a reasonably close comparison to current pesticide sales for some basins, however the sampling intensity should be reviewed for a small number of basins (Table 17).

The data in the table shows that most basins are relatively close in sampling intensity and relative pesticide sales. The South Saskatchewan River basin is under represented, and the monitoring network could be reviewed. However, many of the surface water monitoring programs in Alberta are focused on nutrients or other water chemistry parameters of interest in that basin, and pesticides are included as part of the package of analysis, but not necessarily the focus of the program.



**Table 17. Comparison of 1995-2002 pesticide sampling intensity by basin, and 2003 agricultural pesticide sales by basin.**

<b>Basin</b>	<b>No. of Sites</b>	<b>Total No. of Samples Collected</b>	<b>Percentage Distribution of Pesticide Samples Collected by Basin</b>	<b>% of 2003 Ag Pesticide Sales</b>	<b>Pesticide Detection Frequency by Basin</b>
Hay	1	12	0.4	--	0
Slave	1	10	0.3	--	10.0
Peace	17	262	8.6	9.7	38.5
Athabasca	20	223	7.3	3.1	25.4
Beaver	12	20	0.7	0.9	36.4
North Sask.	78	515	16.9	15.0	63.6
Battle	36	188	6.2	14.6	78.6
Red Deer	49	552	18.1	17.6	73.1
Sounding Creek	2	15	0.5	1.5	77.7
Bow	30	406	13.3	7.1	68.4
Oldman	74	781	25.6	21.4	77.7
South Sask.	3	65	2.1	8.6	81.7
Milk	4	6	0.2	0.5	66.7
Totals	326	3055			65

## 5.0 CONCLUSIONS

This overview of pesticide sales data collected for 2003 provides a general background for assessing pesticide management programs and pesticide monitoring programs. Product breakdowns and regional distributions are comparable to results observed in 1998, although increasing utilization of glyphosate was observed.

Key results of the 2003 survey are:

- Total sales volume was just over 9.2 million kg of active ingredient.
- Herbicides and plant growth regulators made up 77.3% of the total volume sold.
- Of the chemical groups, the Phosphonic/Phosphinic Acid group had the highest sales, comprising 38.1% of total pesticide sales.
- The Agriculture sector accounted for 96.2% of all pesticides sold in Alberta, with 78% of that being herbicides, and 4.5% being insecticides. The insecticide sales volume was relatively high for Alberta, as 2003 was an outbreak year for grasshoppers.
- The Domestic sector accounted for 0.6% of total pesticide sales, with herbicides making up 60.1% and insecticides 35.2%.
- Spatially, the Oldman, Red Deer, North Saskatchewan and Battle River basins each had over 1 million kg ai of pesticide sales.
- The Central Parkland natural region had the largest volume of sales by natural region, at just over 3 million kg ai.
- Average agricultural pesticide use intensity for Alberta was estimated at 0.78 kg ai/ha.

## 6.0 REFERENCES

- AAFRD. 2002. 2001 Census of Agriculture for Alberta. I.D., M.D., and County Data by Region. Alberta Agriculture, Food and Rural Development, Statistics and Data Development, Agdex 852-1. Edmonton. 153 pp.
- AAFRD. 2003a. Crop Protection 2003. Agdex 606-1. Alberta Agriculture, Food and Rural Development, Crop Diversification Division. Edmonton. 516 pp.
- AAFRD. 2003b. Canada-Alberta Environmentally Sustainable Agriculture Agreement (CAESA): Soil Inventory Project Procedures Manual – Data Dictionary. Alberta Agriculture, Food and Rural Development. Published online February 2003 ([www1.agric.gov.ab.ca](http://www1.agric.gov.ab.ca))
- Anderson, A-M. 2005. Overview of Pesticide Data in Alberta Surface Waters Since 1995. Alberta Environment, Monitoring and Evaluation Branch, Edmonton. 172 pp.
- Ball, S. 2006. Alberta Agriculture and Food, Program Compliance Unit, personal communication.
- Brimble, S., P. Bacchus and P.-Y. Caux. 2005. Pesticide Utilization in Canada: A Compilation of Current Sales and Use Data. Environment Canada, Ottawa. 144 pp.
- Byrtus, G. 2000. Overview of 1998 Pesticide Sales in Alberta. Alberta Environment, Edmonton. 58 pp.
- Canola Council of Canada. 2005. Canadian Canola Industry-Market Statistics – Dec 14, 2005. [www.canola-council.org](http://www.canola-council.org)
- Cotton, M.M. and G. Byrtus. 1995. Pesticide Sales Trends in Alberta. Appendix A2. 66 pp in Cross, P. et al. Phase 2. Selection of Soil Landscape Units and Study Design Considerations for the Surface Water Quality Monitoring Program. Prepared for CAESA Water Quality Monitoring Committee. Edmonton.
- CAESA. 1998. Agricultural Impact on Water Quality in Alberta: An Initial Assessment. Prepared for Canada-Alberta Environmentally sustainable Agriculture Water Quality Committee. Alberta Agriculture, Food and Rural Development. Lethbridge. 95 pp.
- Ecological Stratification Working Group. 1995. A National Ecological Framework for Canada. Agriculture and Agri-Food Canada, Research Branch, Centre for Land and Biological Resources Research and Environment Canada, State of the Environment Directorate, Ecozone Analysis Branch, Ottawa/Hull. 121 pp report and national map at 1:7 500 000 scale.
- EPA. 2004. Pesticides Industry Sales and Usage. 2000 and 2001 Market Estimates. United States Environmental Protection Agency, Office of Pesticide Programs. Report 733-R-04-001. Washington, D.C. 33 pp.
- Gregoire, F. 1997. Overview of 1995 Pesticide Sales in Quebec. Quebec Department of Environment and Wildlife, Pesticides Division. 19 pp.

- Gorse, I. 1999. Bilan des ventes de pesticides au Quebec en 1997. Directions des politiques du secteur agricole, Division des pesticides. Ministere de L'Environnement du Quebec, Envirodoq EN950037, PES-14, 116 pp.
- Hartmann, M. 2005. Alberta Agriculture and Food. Personal communication.
- Martin, F.R.J. 2001. Addendum #8 to Hydrology Report #104. The Determination of Gross and Effective Drainage Areas in the Prairie Provinces. Agriculture and Agri-Food Canada, PFRA, Regina. 109 pp.
- Pekalski, B. 1995. A Historical Series of Agricultural Statistics for Alberta: Selected Statistics from the Census of Agriculture. Alberta Agriculture, Food and Rural Development, Market Analysis and Statistics Branch. Edmonton, AB 33 pp.
- Strong, W.L. and J.M. Thompson. 1995. Ecodistricts of Alberta: Summary of Biophysical Attributes. Prepared for Alberta Environmental Protection, Edmonton. 92 pp. + maps.
- Environment Canada. 2005. Water Survey of Canada - Water Data Products and Services; National Climate Data and Information Archive - Climate Normals and Averages. ([www.wsc.ec.gc.ca](http://www.wsc.ec.gc.ca))

# Appendix 1. Chemical Groups and Active Ingredients

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Alcohols	1,2-ETHANEDIOL	Adjuvant
	ABAMECTIN	Insecticide
	BRONOPOL	Preservative
	BUTOXYPOLYPROPYLENE GLYCOL	Insecticide
	CHOLECALCIFEROL	Vertebrate
	ERGOCALCIFEROL	Vertebrate
	NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant
	OCTYLPHENOXYPOLYETHOXYETHANOL PHOSPHATE ESTER	Adjuvant
	SILOXYLATED POLYETHER	Adjuvant
Amides, Anilines	DEET	Insecticide
	FENHEXAMID	Fungicide
	MEFENOXAM	Fungicide
	METALAXYL	Fungicide
	METOLACHLOR	Herbicide
	NAPROPAMIDE	Herbicide
	PROPANIL	Herbicide
	PROPYZAMIDE	Herbicide
	S-METOLACHLOR	Herbicide
	TEBUFENOZIDE	Insecticide
Amino Acids	FLAMPROP-M-METHYL	Herbicide
	HYDRAMETHYLNON	Insecticide
	IMIDACLOPRID	Insecticide
	<i>STREPTOMYCES GRISEOVIRIDIS</i>	Fungicide
	STREPTOMYCIN	Fungicide
	THIAMETHOXAM	Insecticide
Ammoniums, Quaternary	CHLORMEQUAT	Plant Growth Regulator
	DIDECYL DIMETHYL AMMONIUM CHLORIDE	Disinfectant
	DIFENZOQUAT	Herbicide
	DIQUAT	Herbicide
	N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	Disinfectant
	PARAQUAT	Herbicide
Aryloxyphenoxyl Acids	CLODINAFOP-PROPARGYL	Herbicide
	DICLOFOP-METHYL	Herbicide
	FENOXAPROP-ETHYL	Herbicide
	FENOXAPROP-P-ETHYL	Herbicide
	FLUAZIFOP-P-BUTYL	Herbicide
	QUIZALOFOP-ETHYL	Herbicide
	QUIZALOFOP-P-ETHYL	Herbicide
Azoles, Diazoles, Oxazoles,	AMITROLE	Herbicide
	BENTAZON	Herbicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Thiazoles, Triazoles	DIFENOCONAZOLE	Fungicide
	ETRIDIAZOLE	Fungicide
	FLORASULAM	Herbicide
	FLUCARBAZONE SODIUM	Herbicide
	MYCLOBUTANIL	Fungicide
	OXADIAZON	Herbicide
	PACLOBUTRAZOL	Plant Growth Regulator
	PROPICONAZOLE	Fungicide
	STRYCHNINE	Vertebrate
	TEBUCONAZOLE	Fungicide
	TRIADIMENOL	Fungicide
	TRITICONAZOLE	Fungicide
Bacillus thuringiensis species	<i>BACILLUS THURINGIENSIS SSP KURSTAKI</i>	Insecticide
	<i>BACILLUS THURINGIENSIS SSP ISRAELENSIS</i>	Insecticide
Benzimidazoles, Phenylpyrroles	BENOMYL	Fungicide
	FLUDIOXONIL	Fungicide
	THIABENDAZOLE	Fungicide
	THIOPHANATE-METHYL	Fungicide
Benzonitriles, Nitriles	BROMOXYNIL	Herbicide
	CHLOROTHALONIL	Fungicide
	DICHOLOBENIL	Herbicide
Carbamates	BENDIOCARB	Insecticide
	CARBARYL	Insecticide
	CARBOFURAN	Insecticide
	CHLORPROPHAM	Herbicide
	METHIOCARB	Insecticide
	METHOMYL	Insecticide
	OXAMYL	Insecticide
	PIRIMICARB	Insecticide
	PROPAMOCARB HYDROCHLORIDE	Fungicide
	PROPOXUR	Insecticide
Carboxylic Acids	CLOPYRALID	Herbicide
	DICAMBA	Herbicide
	IMAZAMETHABENZ	Herbicide
	IMAZAMOX	Herbicide
	IMAZETHAPYR	Herbicide
	IMAZYPYR	Herbicide
	METHYL ANTHRANILATE	Vertebrate
	OXINE BENZOATE	Fungicide
	PICLORAM (ACID, ISOCTYL ESTERS, POTASSIUM SALT OR AMINE SALTS)	Herbicide
	TRICLOPYR	Herbicide
	TRINEXAPAC-ETHYL	Plant Growth Regulator

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
Chromenones	BRODIFACUUM	Vertebrate
	BROMADIOLONE	Vertebrate
	ROTENONE	Insecticide
	WARFARIN	Vertebrate
Cyclohexanedione oximes	CLETHODIM	Herbicide
	SETHOXYDIM	Herbicide
	TRALKOXYDIM	Herbicide
Diazines, Quinoxalines, Morpholines	6-BENZYLAMINOPURINE	Plant Growth Regulator
	ANCYMIDOL	Plant Growth Regulator
	AZOXYSTROBIN	Fungicide
	DIMETHOMORPH	Fungicide
	DODEMORPH-ACETATE	Fungicide
	MALEIC HYDRAZIDE	Plant Growth Regulator
	PYRACLOSTROBIN	Fungicide
	PYRAZON	Herbicide
	PYRIDABEN	Insecticide
	PYRIDATE	Herbicide
	QUINCLORAC	Herbicide
	SULFAQUINOXALINE	Vertebrate
	TRIFORINE	Fungicide
Dicarboximides, Oxathiin	CARBATHIIN	Fungicide
	IPRODIONE	Fungicide
	OXYCARBOXIN	Fungicide
	VINCLOZOLIN	Fungicide
Dithiocarbamates	DAZOMET	Fumigant
	DESMEDIPHAM	Herbicide
	FERBAM	Fungicide
	MANCOZEB	Fungicide
	MANEB	Fungicide
	METAM	Fumigant
	METIRAM	Fungicide
	PHENMEDIPHAM	Herbicide
	THIRAM	Fungicide
	ZINEB	Fungicide
Fatty Acids	FATTY ACID	Herbicide
	SAFER'S INSECTICIDAL SOAP	Insecticide
	SOAP	Insecticide
	SOAP (HERBICIDAL)	Herbicide
	TALL OIL FATTY ACIDS	Adjuvant
	TALLOW FATTY ACID AMINE ETHOXYLATE	Adjuvant
Hydrocarbons	ASPHALT SOLIDS	Fungicide
	MUSCALURE	Insecticide



CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	NAPHTHALENE	Insecticide
	PETROLEUM HYDROCARBON BLEND	Adjuvant
	POLYMERIZED BUTENES	Vertebrate
Indanediones	CHLOROPHACINONE	Vertebrate
	DIFETHIALONE	Vertebrate
	DIPHACINONE	Vertebrate
Inorganic Coppers	COPPER NAPHTHENATE	Wood Preservative
	COPPER OXYCHLORIDE	Fungicide
	COPPER SULPHATE	Fungicide
	CUPRIC HYDROXIDE	Fungicide
	TRIBASIC COPPER SULPHATE	Fungicide
Inorganic Zincs	ZINC NAPHTHENATE	Wood Preservative
	ZINC PHOSPHIDE	Vertebrate
Inorganics, Other	ALUMINUM PHOSPHIDE	Insecticide
	AMMONIA	Vertebrate
	AMMONIUM SULPHATE	Adjuvant
	BORACIC ACID	Insecticide
	BORAX	Insecticide
	FERRIC PHOSPHATE	Insecticide
	FERROUS SULFATE	Herbicide
	HYDROGEN PEROXIDE	Insecticide
	LIME SULPHUR OR CALCIUM POLYSULPHIDE	Fungicide
	POTASSIUM MONOPERSULPHATE	Disinfectant
	SILICA AEROGEL	Insecticide
	SILICON DIOXIDE SALT WATER FOSSILS	Insecticide
	SODIUM CHLORATE	Herbicide
	SODIUM METABORATE TETRAHYDRATE	Herbicide
	SULPHUR (FUNGICIDE)	Fungicide
	SULPHUR (INSECTICIDE)	Insecticide
	SULPHUR (VERTEBRATE CONTROL)	Vertebrate
Miscellaneous (Non-classified)	ACETIC ACID	Herbicide
	ACROLEIN	Herbicide
	ETHOFUMESATE	Herbicide
	FORMALDEHYDE	Fungicide
	KINOPRENE	Insecticide
	METALDEHYDE	Insecticide
	METHOPRENE	Insecticide
	METHYL NONYL KETONE	Vertebrate
	MUSTARD SEED POWDER ( <i>BRASSICA HIRTA</i> )	Vertebrate
	N-ALKYL DIETHANOLAMINE	Adjuvant
	N-ALKYL POLYETHOXYETHANOL	Adjuvant
	NATURAL GUM RESINS	Insecticide
	PARAFORMALDEHYDE	Disinfectant
	PIPERONYL BUTOXIDE	Insecticide
	POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant



CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	PYMETROZINE	Insecticide
	SODIUM ALPHA-OLEFIN SULFONATE	Vertebrate
	SPINOSAD FACTOR A PLUS	Insecticide
	WATER SOLUBLE DYES	Herbicide
Nitro Derivatives	ETHALFLURALIN	Herbicide
	OXYFLUORFEN	Herbicide
	PENDIMETHALIN	Herbicide
	TRIFLURALIN	Herbicide
Oils, Mineral and Vegetable	MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide
	OIL OF BLACK PEPPER	Vertebrate
	OLEORESIN CAPSICUM (CAPSAICIN)	Vertebrate
	PARAFFIN BASE MINERAL OIL (ADJUVANT)	Adjuvant
	PARAFFIN BASE PETROLEUM OIL	Adjuvant
	PIPERINE	Vertebrate
	P-MENTHANE-3, 8-DIOL	Insecticide
	SURFACTANT BLEND	Adjuvant
Organic Acids	DAMINOZIDE	Plant Growth Regulator
	GIBBERELIC ACID	Plant Growth Regulator
Organochlorines	CHLORONEB	Fungicide
	DICOFOL	Insecticide
	ENDOSULFAN	Insecticide
	LINDANE	Insecticide
	METHOXYCHLOR	Insecticide
	PARADICHLOROBENZENE	Insecticide
	QUINTOZENE	Fungicide
Organometallics	10,10'-OXYBIS(PHENOXARSINE)	Preservative
	FENBUTATIN OXIDE	Insecticide
Organophosphorous	ACEPHATE	Insecticide
	AZINPHOS-METHYL	Insecticide
	BENSULIDE	Herbicide
	CHLORPYRIFOS	Insecticide
	COUMAPHOS	Insecticide
	DIAZINON	Insecticide
	DICHLORVOS	Insecticide
	DIMETHOATE	Insecticide
	FENTHION	Insecticide
	FOSETYL-AL	Fungicide
	MALATHION	Insecticide
	METHAMIDOPHOS	Insecticide
	NALED	Insecticide
	PHORATE	Insecticide
	PHOSALONE	Insecticide
	PHOSMET	Insecticide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	PROPETAMPHOS	Insecticide
	TERBUFOS	Insecticide
Phenols	CREOSOTE	Wood Preservative
Phenoxy Acids	2,4-D (ACID, AMINE SALTS, OR LOW VOLATILE ESTERS)	Herbicide
	2,4-DB (MIXED BUTYL ESTERS OR ISOCTYL ESTERS)	Herbicide
	DICHLORPROP	Herbicide
	MCPA (ACID, AMINE SALTS, ESTERS, POTASSIUM SALTS OR SODIUM SALTS)	Herbicide
	MCPB PRESENT AS SODIUM SALT	Herbicide
	MECOPROP (D-ISOMER) PRESENT AS ACID, AMINE SALTS OR POTASSIUM SALTS)	Herbicide
Phosphonic Acids, Phosphinic Acids	ETHEPHON	Plant Growth Regulator
	GLUFOSINATE AMMONIUM	Herbicide
	GLYPHOSATE (ACID, ISOPROPYLAMINE SALT, MONO-AMMONIUM SALT OR TRIMETHYLSULFONIUM SALT)	Herbicide
	TRICHLORFON	Insecticide
Phthalic Acids	CAPTAN	Fungicide
	ENDOTHALL	Herbicide
	FOLPET	Fungicide
	N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide
Pyrethroids, Pyrethrins	ALLETHRIN	Insecticide
	CYFLUTHRIN	Insecticide
	CYHALOTHRIN-LAMBDA	Insecticide
	CYPERMETHRIN	Insecticide
	D-CIS, TRANS ALLETHRIN	Insecticide
	DELTAMETHRIN	Insecticide
	D-PHENOTHRIN	Insecticide
	D-TRANS ALLETHRIN	Insecticide
	FENVALERATE	Insecticide
	PERMETHRIN	Insecticide
	PYRETHRINS	Insecticide
	RESMETHRIN	Insecticide
Pyridines	TETRAMETHRIN	Insecticide
	4-AMINOPYRIDINE	Vertebrate
	DI-N-PROPYL ISOCINCHOMERONATE	Insecticide
	DITHIOPYR	Herbicide
	FLUROXYPYR	Herbicide
Sulfonylureas, Uracils	NICOTINE	Insecticide
	BROMACIL	Herbicide
	CHLORSULFURON	Herbicide
	ETHAMETSULFURON-METHYL	Herbicide
	METSULFURON-METHYL	Herbicide
	NICOSULFURON	Herbicide
	RIMSULFURON	Herbicide

CHEMICAL GROUP	ACTIVE INGREDIENT NAME	TYPE OF USE
	SULFOSULFURON	Herbicide
	TERBACIL	Herbicide
	THIFENSULFURON METHYL	Herbicide
	TRIASULFURON	Herbicide
	TRIBENURON METHYL	Herbicide
	TRIFLUSULFURON METHYL	Herbicide
Thiocarbamates	CYCLOATE	Herbicide
	EPTC	Herbicide
	TRIALATE	Herbicide
Triazines, Triazinones, Tetrazines	ATRAZINE	Herbicide
	CYANAZINE	Herbicide
	CYROMAZINE	Insecticide
	HEXAZINONE	Herbicide
	METRIBUZIN	Herbicide
	PROMETRYNE	Herbicide
	SIMAZINE	Herbicide
Urea Derivatives	1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	Anti-microbial
	CYMOXANIL	Fungicide
	DIFLUBENZURON	Insecticide
	DIURON	Herbicide
	LINURON	Herbicide

**Appendix 2. Alberta 2003 Pesticide Sales by Active Ingredient**

ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
GLYPHOSATE	Herbicide	3 419 822.1	36.9	2 682 748.9
MCPA	Herbicide	1 097 359.0	118	885 239.1
2,4-D	Herbicide	763 357.7	8.2	765 820.4
PETROLEUM HYDROCARBON BLEND	Adjuvant	559 728.7	6.0	368 704.3
SURFACTANT BLEND	Adjuvant	438 235.7	4.7	496 561.7
BROMOXYNIL	Herbicide	354 906.6	3.8	268 105.3
CHLORPYRIFOS	Insecticide	197 765.5	2.1	217 397.5
TRIALATE	Herbicide	197 221.4	2.1	693 178.5
PARAFFIN BASE MINERAL OIL (ADJUVANT)	Adjuvant	192 634.4	2.1	193 162.6
ETHALFLURALIN	Herbicide	168 135.0	1.8	452 294.4
TRALKOXYDIM	Herbicide	141 226.1	1.5	126 323.5
IMAZAMETHABENZ	Herbicide	138 551.4	1.5	173 679.2
DICAMBA	Herbicide	121 422.7	1.3	138 278.6
GLUFOSINATE AMMONIUM	Herbicide	107 255.5	1.2	63 863.8
CARBARYL	Insecticide	104 430.6	1.1	3 142.8
FENOXAPROP-P-ETHYL	Herbicide	64 212.1	0.69	59 919.0
NONYLPHENOXYPOLYETHOXYETHANOL	Adjuvant	59 558.8	0.64	94 247.3
DICHLORPROP	Herbicide	57 450.1	0.62	40 942.4
CLOPYRALID	Herbicide	56 618.0	0.61	59 019.7

ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
AMMONIUM SULPHATE	Herbicide	51 595.1	0.56	71 104.4
CLODINAFOF-PROPARGYL	Herbicide	49 520.8	0.53	34 408.9
CARBATHIIN	Fungicide	45 228.3	0.49	122 292.0
CHLOROTHALONIL	Fungicide	43 208.6	0.47	37 334.0
FLUROXYPYR	Herbicide	43 166.7	0.47	23 700.8
PHORATE	Insecticide	41 417.3	0.45	19 209.0
TRIFLURALIN	Herbicide	40 654.3	0.44	230 028.2
MANCOZEB	Fungicide	36 127.2	0.39	45 813.9
TRICLOPYR	Herbicide	33 116.2	0.36	30 311.8
DIURON	Herbicide	31 096.3	0.34	9 919.3
SETHOXYDIM	Herbicide	30 993.1	0.33	58 678.5
MEFENOXAM	Fungicide	29 813.1	0.32	
PARAFFIN BASE PETROLEUM OIL	Adjuvant	27 958.4	0.30	77 427.2
THIRAM	Fungicide	27 136.3	0.29	22 791.7
MECOPROP-D	Herbicide	26 080.4	0.28	27 264.1
DIQUAT	Herbicide	25 524.4	0.28	21 765.0
FLUDIOXONIL	Fungicide	24 377.7	0.26	
VINCLOZOLIN	Fungicide	24 324.3	0.26	25 823.1
BENTAZON	Herbicide	21 986.9	0.24	12 066.2
IPRODIONE	Fungicide	21 014.3	0.23	9 592.7
PICLORAM	Herbicide	17 897.0	0.19	15 109.4
MALATHION	Insecticide	17 413.8	0.19	22 316.5
ACROLEIN	Herbicide	16 981.4	0.18	17 520.5
SILICON DIOXIDE SALT WATER FOSSILS	Insecticide	15 588.2	0.17	47 025.2
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER	Adjuvant	13 727.9	0.15	9 340.0
PROPICONAZOLE	Fungicide	13 183.4	0.14	5 664.4
EPTC	Herbicide	11 944.0	0.13	38 574.2
2,4-DB	Herbicide	11 501.4	0.12	20 950.3
DIFENOCONAZOLE	Fungicide	11 067.6	0.12	
LINURON	Herbicide	8 991.4	0.10	8754
THIFENSULFURON METHYL	Herbicide	8 572.3	0.09	13 697.5
SILICA AEROGEL	Insecticide	7 785.0	0.08	11 052.5
ETHOFUMESATE	Herbicide	7 742.4	0.08	12 559.4
QUINTOZENE	Fungicide	7 166.5	0.08	9 808.9
CUPRIC HYDROXIDE	Fungicide	6 885.0	0.07	252.5
METRIBUZIN	Herbicide	6 306.3	0.07	7 601.4
FLORASULAM	Herbicide	6 090.5	0.07	
TEBUCONAZOLE	Fungicide	5 922.4	0.06	
FLUAZIFOP-P-BUTYL	Herbicide	5 808.5	0.06	12 914.0
TRIBENURON METHYL	Herbicide	5 404.8	0.06	6 763.6
ENDOSULFAN	Insecticide	5 229.7	0.05	761.1
DIAZINON	Insecticide	5 149.9	0.06	4 087.3
OCTYLPHENOXYPOLYETHOXYETHANOL	Adjuvant	5 144.7	0.06	9 219.0
CYHALOTHRIN-LAMBDA	Insecticide	5 124.4	0.06	1 097.9
IMAZETHAPYR	Herbicide	5 063.2	0.05	10 528.6

ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
LINDANE	Insecticide	4 779.5	0.05	56 743.7
BROMACIL	Herbicide	4 770.3	0.05	3 106.9
ATRAZINE	Herbicide	4 654.5	0.05	5 753.8
DIFENZOQUAT	Herbicide	4 464.0	0.05	9 585.5
QUICALOFOP P-ETHYL	Herbicide	4 461.0	0.05	2 669.7
CLETHODIM	Herbicide	3 694.9	0.04	2 490.7
DEET	Insecticide	3 413.3	0.04	4 167.9
MANEB	Fungicide	3 346.4	0.04	8 462.0
S-METOLACHLOR	Herbicide	3 278.9	0.04	
BENOMYL	Fungicide	3 275.0	0.04	14 616.3
IMAZAMOX	Herbicide	3 122.0	0.03	4 231.8
SULPHUR (FUNGICIDE)	Fungicide	2 968.1	0.03	7 315.4
TERBUFOS	Insecticide	2 893.0	0.03	6 697.8
DELTAMETHRIN	Insecticide	2 735.1	0.03	775.1
TRICHLORFON	Insecticide	2 331.3	0.03	34 334.3
FLUCARBAZONE SODIUM	Herbicide	2 292.2	0.02	
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	Insecticide	2 233.7	0.02	3 477.4
AMITROLE	Herbicide	2 107.0	0.02	2 026.5
TRITICONAZOLE	Fungicide	2 080.4	0.02	
METIRAM	Fungicide	2 068.8	0.02	14 862.4
AZOXYSTROBIN	Fungicide	1 961.1	0.02	
MALEIC HYDRAZIDE	Growth Regulator	1 952.7	0.02	551.7
MCPB	Herbicide	1 717.5	0.02	3 271.5
IMAZYPYR	Herbicide	1 710.0	0.02	200.6
DIMETHOATE	Insecticide	1 691.1	0.02	4 883.4
FERROUS SULFATE	Herbicide	1 593.4	0.02	1 818.7
PARAQUAT	Herbicide	1 591.6	0.02	4 820.4
ACETIC ACID	Herbicide	1 555.5	0.02	
THIABENDAZOLE	Fungicide	1 388.8	0.01	3 187.2
DESMEDIPHAM	Herbicide	1 348.5	0.01	2 334.8
PHENMEDIPHAM	Herbicide	1 348.5	0.01	2 330.3
PYRACLOSTROBIN	Fungicide	1 263.6	0.01	
THIAMETHOXAM	Insecticide	1 176.2	0.01	
SIMAZINE	Herbicide	1 160.4	0.01	3 688.1
SILOXYLATED POLYETHER	Adjuvant	1 130.9	0.01	
SAFER'S INSECTICIDAL SOAP	Insecticide	1 040.2	0.01	1 641.6
METHAMIDOPHOS	Insecticide	1 008.0	0.01	19.2
HYDROGEN PEROXIDE	Insecticide	996.8	0.01	
IMIDACLOPRID	Insecticide	978.0	0.01	9.5
NALED	Insecticide	972.6	0.01	1 257.9
SOAP	Insecticide	947.2	0.01	
HEXAZINONE	Herbicide	940.9	0.01	2 428.1
QUINCLORAC	Herbicide	878.1	0.01	1 459.4
ETHAMETSULFURON-METHYL	Herbicide	844.4	0.01	4 636.4
PENDIMETHALIN	Herbicide	782.8	0.01	1 061.1



ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
DICLOFOP-METHYL	Herbicide	715.2	0.01	3 239.9
DICHO BENIL	Herbicide	684.7	0.01	728.2
CARBOFURAN	Insecticide	676.1	0.01	6 413.4
COPPER SULPHATE	Fungicide	672.1	0.01	316.1
COPPER OXYCHLORIDE	Fungicide	649.5	0.01	220.2
SULFOSULFURON	Herbicide	596.3	0.01	
ASPHALT SOLIDS	Fungicide	591.9	0.01	1 387.5
PROMETRYNE	Herbicide	586.3	0.01	
MUSTARD SEED POWDER (BRASSICA HIRTA)	Rodenticide	471.3	0.01	
CYCLOATE	Herbicide	460.8	0.00	2 289.6
THIOPHANATE-METHYL	Fungicide	454.7	0.00	859.4
CAPTAN	Insecticide	439.4	0.00	286.8
METHOMYL	Insecticide	436.8	0.00	434.5
ZINC PHOSPHIDE	Rodenticide	435.3	0.00	49.2
FENTHION	Insecticide	418.8	0.00	293.6
METAM	Soil fumigant	415.1	0.00	410.7
PROPAMOCARB HYDROCHLORIDE	Fungicide	411.9	0.00	1 271.3
PIPERONYL BUTOXIDE	Insecticide	405.1	0.00	591.6
ACEPHATE	Insecticide	383.6	0.00	257.6
BUTOXYPOLYPROPYLENE GLYCOL	Insecticide	370.2	0.00	2.3
LIME SULPHUR	Fungicide	364.8	0.00	224
METSULFURON-METHYL	Herbicide	360.9	0.00	938.6
FOSETYL-AL	Fungicide	351.8	0.00	166.3
PYRAZON	Herbicide	338.0	0.00	1 204.9
TERBACIL	Herbicide	332.8	0.00	891.2
D-TRANS ALLETHRIN	Insecticide	320.6	0.00	20.7
PERMETHRIN	Insecticide	315.8	0.00	397.2
AZINPHOS-METHYL	Insecticide	304.0	0.00	260.6
METALAXYL	Fungicide	302.2	0.00	3 796.2
SODIUM ALPHA-OLEFIN SULFONATE	Rodenticide	299.1	0.00	
ALUMINUM PHOSPHIDE	Insecticide	269.6	0.00	2 215.7
STRYCHNINE	Rodenticide	244.8	0.00	163.2
CHLORONEB	Fungicide	233.9	0.00	559.3
PYRETHRINS	Insecticide	220.9	0.00	178.2
RIMSULFURON	Herbicide	219.1	0.00	63.2
DICHLORVOS	Insecticide	193.5	0.00	335.2
BRONOPOL	Preservative	192.1	0.00	
TRIASULFURON	Herbicide	190.3	0.00	505
SULPHUR (VERTEBRATE CONTROL)	Rodenticide	185.4	0.00	1 045.3
OXYCARBOXIN	Fungicide	185.3	0.00	154.1
PROPYZAMIDE	Herbicide	179.4	0.00	272
TALL OIL FATTY ACIDS	Adjuvant	176.0	0.00	1 470.4
BORAX	Insecticide	168.2	0.00	218.8
DIDECYL DIMETHYL AMMONIUM CHLORIDE	Anti-microbial	167.4	0.00	120.6
N-ALKYL DIMETHYL BENZYL AMMONIUM CHLORIDE	Disinfectant	163.4	0.00	63.7

ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
MYCLOBUTANIL	Fungicide	162.6	0.00	16.8
PIRIMICARB	Insecticide	162.2	0.00	154.1
NAPROPAMIDE	Herbicide	159.1	0.00	294.6
PHOSMET	Insecticide	140.7	0.00	370
NICOSULFURON	Herbicide	140.1	0.00	
TALLOW FATTY ACID AMINE ETHOXYLATE	Adjuvant	138.1	0.00	3 272.2
TRIBASIC COPPER SULPHATE	Fungicide	130.9	0.00	159.6
ETRIDIAZOLE	Herbicide	122.1	0.00	210.6
CHLORPROPHAM	Herbicide	120.4	0.00	679.8
TRIADIMENOL	Fungicide	120.1	0.00	178
DAMINOZIDE	Growth Regulator	119.9	0.00	147.5
NAPHTHALENE	Insecticide	118.5	0.00	1 371.6
SODIUM METABORATE TETRAHYDRATE	Herbicide	117.5	0.00	1 616.3
ETHEPHON	Fungicide	115.2	0.00	31.2
PROPOXUR	Insecticide	107.2	0.00	170
METALDEHYDE	Insecticide	101.3	0.00	476.5
ZINEB	Fungicide	99.5	0.00	491.7
CHLORSULFURON	Herbicide	98.6	0.00	66.7
SULPHUR (INSECTICIDE)	Insecticide	96.6	0.00	280.7
PROPANIL	Herbicide	96.0	0.00	1616
BENSULIDE	Herbicide	95.9	0.00	212.6
FERBAM	Herbicide	95.1	0.00	77.6
PYMETROZINE	Insecticide	95.0	0.00	
CYFLUTHRIN	Insecticide	92.3	0.00	1.3
CHLORMEQUAT	Growth Regulator	89.7	0.00	62.3
FATTY ACID	Growth Regulator	88.9	0.00	34.6
DICOFOL	Insecticide	84.0	0.00	423.6
TRIFLUSULFURON METHYL	Herbicide	81.8	0.00	
DAZOMET	Soil fumigant	78.4	0.00	627.2
PARAFORMALDEHYDE	Disinfectant	68.3	0.00	
CYMOXANIL	Fungicide	65.9	0.00	
ROTENONE	Herbicide	61.7	0.00	180.0
OCTYLPHENOXYPOLYETHOXYETHANOL PHOSPHATE ESTER	Adjuvant	60.5	0.00	
POTASSIUM MONOPERSULPHATE	Disinfectant	59.9	0.00	15
COPPER NAPHTHENATE	Anti-microbial	59.8	0.00	123.2
CREOSOTE	Anti-microbial	58.1	0.00	805.2
FOLPET	Insecticide	55.4	0.00	54.8
SODIUM CHLORATE	Herbicide	53.0	0.00	729.1
OXINE BENZOATE	Fungicide	52.5	0.00	59.1
WATER SOLUBLE DYES	Herbicide	48.7	0.00	5.1
OXYFLUORFEN	Herbicide	46.0	0.00	27.4
CYANAZINE	Herbicide	45.0	0.00	3 891.6
TRINEXAPAC-ETHYL	Growth Regulator	44.8	0.00	
QUIZALOFOP-ETHYL	Herbicide	44.7	0.00	23 101.0

ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
ENDOTHALL	Herbicide	44.3	0.00	511.0
DODEMORPH-ACETATE	Fungicide	42.8	0.00	55.2
SOAP (HERBICIDAL)	Herbicide	42.4	0.00	1221.5
BORACIC ACID	Insecticide	41.6	0.00	322.7
BENDIOCARB	Insecticide	36.0	0.00	59.3
<i>BACILLUS THURINGIENSIS SSP KURSTAKI</i>	Insecticide	35.8	0.00	28 273.5*
<i>BACILLUS THURINGIENSIS SSP ISRAELENIS</i>	Insecticide	34.4	0.00	11 079.8*
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	Insecticide	33.4	0.00	144.5
N-ALKYL POLYETHOXYETHANOL	Adjuvant	32.5	0.00	52.5
METHYL NONYL KETONE	Rodenticide	27.5	0.00	50.0
NICOTINE	Insecticide	27.2	0.00	27.5
CYPERMETHRIN	Insecticide	26.1	0.00	439.6
METHOXYCHLOR	Insecticide	24.7	0.00	109.9
ZINC NAPHTHENATE	Anti-microbial	23.6	0.00	40.0
PHOSALONE	Insecticide	23.5	0.00	5.6
PYRIDABEN	Insecticide	23.5	0.00	17.1
P-MENTHANE-3, 8-DIOL	Insecticide	22.7	0.00	
1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	Anti-microbial	22.4	0.00	20.5
FENBUTATIN OXIDE	Insecticide	22.1	0.00	12.4
TRIFORINE	Fungicide	22.0	0.00	20.6
POLYMERIZED BUTENES	Rodenticide	21.7	0.00	92.9
N-ALKYL DIETHANOLAMINE	Adjuvant	20.8	0.00	33.6
HYDRAMETHYLNON	Insecticide	20.4	0.00	9.2
TETRAMETHRIN	Insecticide	20.3	0.00	14.2
OXADIAZON	Herbicide	19.9	0.00	41.2
FORMALDEHYDE	Fungicide	17.8	0.00	96.2
RESMETHRIN	Insecticide	17.5	0.00	2.4
1,2-ETHANEDIOL	Adjuvant	17.4	0.00	87.0
OIL OF BLACK PEPPER	Rodenticide	16.5	0.00	12.0
PARADICHLOROBENZENE	Insecticide	13.9	0.00	65.3
PYRIDATE	Herbicide	12.6	0.00	486.0
METHIOCARB	Insecticide	12.1	0.00	
FERRIC PHOSPHATE	Insecticide	11.3	0.00	
METOLACHLOR	Herbicide	11.2	0.00	4 297.9
DIMETHOMORPH	Fungicide	9.9	0.00	72.9
KINOPRENE	Insecticide	9.9	0.00	33.6
CYROMAZINE	Insecticide	9.8	0.00	
TEBUFENOZIDE	Insecticide	8.6	0.00	
COUMAPHOS	Insecticide	7.3	0.00	45.6
D-PHENOTHRIN	Insecticide	6.8	0.00	
ABAMECTIN	Insecticide	6.7	0.00	3.6
METHOPRENE	Insecticide	6.7	0.00	
DI-N-PROPYL ISOCINCHOMERONATE	Insecticide	5.8	0.00	6.4
D-CIS, TRANS ALLETHRIN	Insecticide	5.7	0.00	1.7
10,10'-OXYBIS(PHENOXARSINE)	Preservative	5.3	0.00	



ACTIVE INGREDIENT NAME	Type of use	2003 total (kg ai)	2003 %	1998 total (kg ai)
ETHION	Insecticide	4.6	0.00	26.9
METHYL ANTHRANILATE	Rodenticide	4.1	0.00	
FENVALERATE	Fungicide	3.8	0.00	4.1
ALLETHRIN	Insecticide	2.8	0.00	2.0
DIFLUBENZURON	Insecticide	2.6	0.00	
FENHEXAMID	Fungicide	2.5	0.00	
OXAMYL	Insecticide	2.4	0.00	9.6
WARFARIN	Rodenticide	2.0	0.00	1.8
SPINOSAD FACTOR A PLUS	Insecticide	1.9	0.00	
CHLORPHACINONE	Rodenticide	1.7	0.00	1.8
BROMADIOLONE	Rodenticide	1.2	0.00	1.2
STREPTOMYCIN	Fungicide	1.0	0.00	2.1
NATURAL GUM RESINS	Insecticide	0.67	0.00	9.0
PIPERINE	Rodenticide	0.62	0.00	0.4
AMMONIA	Rodenticide	0.43	0.00	1.1
SULFAQUINOXALINE	Rodenticide	0.41	0.00	1.4
DIPHACINONE	Rodenticide	0.37	0.00	0.4
PROPETAMPHOS	Insecticide	0.29	0.00	
PACLOBUTRAZOL	Growth Regulator	0.23	0.00	
4-AMINOPYRIDINE	Rodenticide	0.21	0.00	1.5
MUSCALURE	Insecticide	0.16	0.00	0.6
CAPSAICIN	Rodenticide	0.10	0.00	0.1
FLAMPROP-M-METHYL	Herbicide	0.08	0.00	1 091.5
BRODIFACUM	Rodenticide	0.08	0.00	0.1
GIBBERELIC ACID	Growth Regulator	0.06	0.00	0.6
DIFETHIALONE	Rodenticide	0.06	0.00	
DITHIOPYR	Herbicide	0.05	0.00	2.1
6-BENZYLAMINOPURINE	Growth Regulator	0.04	0.00	
<i>STREPTOMYCES GRISEOVIRIDIS</i>	Fungicide	0.04	0.00	
ANCYMIDOL	Growth Regulator	0.03	0.00	0.1
CHOLECALCIFEROL	Rodenticide	0.012	0.00	0.1
FENOXAPROP-ETHYL	Herbicide	0.012	0.00	117.9
ERGOCALCIFEROL	Rodenticide	0.002	0.00	0.02
<b>GRAND TOTAL</b>		<b>9 264 487.7</b>	<b>100.0</b>	

Note: *Bacillus thuringiensis* active ingredient calculations in 1998 assumed that formulation consisted of 100% active ingredient, as guarantees on a percentage basis were not available. Guarantees on a percentage basis were obtained for these products in 2003. Recalculating the 1998 figures resulted in total active ingredient sold for *Bt kurstaki* and *Bt israelensis* of 617.994 and 1.654 kg ai, respectively.

Appendix 3. Pesticide Sales by Active Ingredient and River Basin

Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
1,2-ETHANEDIOL	17.4													17.4
10,10'-OXYBIS(PHENOXARSINE)	5.3													5.3
1-BROMO-3-CHLORO-5,5-DIMETHYLHYDANTOIN	19.1				3.3									22.4
2,4-D	41527.8	9680.9	78147.3	2566.1	66923.1		7437.9	65007.2	218541.8	26556.3	129600.4	11609.3	105759.6	763357.7
2,4-DB	8	694.5	1136.3	166.5	111.3			1150.0	1150.0	4866.0	1986.7	38.8	193.5	11501.4
4-AMINOPYRIDINE	0.2													0.2
6-BENZYLAMINOPURINE	0.04													0.04
ABAMECTIN	5.2	0.0009	0.0010	0.0002	1.5			0.003	0.0003	0.0002	0.001	0.00002	0.0002	6.7
ACEPHATE	153.0				19.1			13.5	13.5		7.9		176.6	383.6
ACETIC ACID	927.3	74.4	37.5	15.0	82.5			135.0	89.4	51.9	112.5		30.0	1555.5
ACROLEIN					1543.8				6020.7		3859.4		5557.5	16981.4
ALLETHRIN		0.3	0.4		0.4			0.3	0.05	0.8	0.4	0.1	6.1	2.8
ALUMINUM PHOSPHIDE	234.7				1.8				32.7		0.3			269.6
AMITROLE	2.3	0.2	336.3		97.0		147.8	30.5	552.7	123.0	791.7	0.04	25.4	2107.0
AMMONIA		0.04	0.08		0.04			0.05	0.02	0.1	0.02		0.08	0.4
AMMONIUM SULPHATE		198.0	891.0	9.9	980.1			752.4	21255.3	4252.1	7962.8		15293.5	51595.1
ANCYMIDOL	0.03				0.001									0.03
ASPHALT SOLIDS	375.8	1.6	3.9		90.1			79.1	23.4	3.6	12.4		2.0	591.9
ATRAZINE	0.2	1.0	848.2		390.5			405.6	1940.8	11.9	432.3		624.1	4654.5
AZINPHOS-METHYL								127.6	85.6				90.8	304.0
AZOXYSTROBIN	44.5	0.9	63.8	0.9	7.3			34.0	1433.6		12.3		363.8	1961.1
<i>BACILLUS THURINGIENSIS</i> SSP <i>ISRAELENIS</i>	27.7	0.2	0.3	0.04	3.8			1.3	0.3	0.3	0.4	0.076	0.1	34.4
<i>BACILLUS THURINGIENSIS</i> SSP <i>KURSTAKI</i>	10.6	0.02	0.002	0.005	1.5			4.5	0.03	0.02	1.4		17.8	35.8
BENDIOCARB	27.0				9.0									36.0
BENOMYL	57.5	61.0	62.5	500.0	1112.0			962.5	187.0	160.0	25.0		147.5	3275.0

Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
BENSULIDE	95.1									0.8				95.9
BENTAZON		150.7	727.7	8.6	246.2			286.1	11117.3	349.9	1737.6		7362.7	21986.9
BORACIC ACID	25.1	0.8	3.4		3.7			2.6	1.7	1.6	1.5		1.1	41.6
BORAX	85.2	5.5	6.7	0.8	21.5			26.6	5.6	3.8	8.6	0.3	3.7	168.2
BRODIFACOU	0.01	0.01	0.01	0.00004	0.02			0.01	0.01	0.003	0.01		0.002	0.08
BROMACIL	3050.4	27.5	64.5	11.7	32.9			224.4	197.8	43.7	64.7	0.8	1052.1	4770.3
BROMADIOLONE	0.6	0.07	0.1	0.0009	0.06			0.2	0.04	0.06	0.08	0.002	0.02	1.2
BROMOXYNIL		1709.6	34342.5	1144.6	34270.6		4188.0	29164.0	99037.6	4910.1	77386.9	9156.9	59595.9	354906.6
BRONOPOL					84.6			66.5	15.0	10.1	15.9			192.1
BUTOXYPOLYPROPYLENE GLYCOL	35.0	33.0	12.5	4.5	49.5			92.2	8.0	45.7	82.7	0.4	6.7	370.2
CAPSAICIN	0.08	0.0002	0.002	0.0004	0.01			0.008	0.002	0.001	0.004		0.002	0.1
CAPTAN	226.3	1.0	121.8	0.6	22.5			12.4	34.7	0.7	17.6	0.05	1.7	439.4
CARBARYL	1370.7	34859.3	9683.2	5969.0	1867.0	0.45	2.1	22737.6	3757.2	2617.1	17568.4	2520.0	1478.5	104430.6
CARBATHIIN	238.2	455.9	5338.0	177.9	5268.2		1060.4	4265.6	12285.8	4559.2	7013.6	313.7	4251.8	45228.3
CARBOFURAN			11.52		221.0			32.6	272.6		5.8		132.5	676.1
CHLORMEQUAT	89.7													89.7
CHLORONEB		54.9	20.2		2.6			42.4	26.0	32.8	47.2	3.9	3.9	233.9
CHLOROPHACINONE	1.1	0.02	0.04	0.002	0.08			0.2	0.1	0.01	0.1		0.02	1.7
CHLOROTHALONIL	2682.7	194.1	747.2		2150.8			3547.2	31535.9	20.2	318.6		2011.9	43208.6
CHLORPROPHAM									120.4					120.4
CHLORPYRIFOS	0.01	3154.3	22326.8	2440.8	39326.8		1180.8	20131.1	58344.7	1501.0	37739.1	6410.5	5209.6	197765.5
CHLORSULFURON	90.0		6.0					0.8			0.8		1.1	98.6
CHOLECALCIFEROL	0.01													0.01
CLETHODIM		269.9	501.3	8.6	147.6		24.5	871.2	530.9	573.8	483.8	23.0	260.2	3694.9
CLODINAPOP-PROPARGYL		1059.6	8389.6	253.9	2942.3		436.3	7829.5	9337.3	6105.1	6539.0	960.5	5667.8	49520.8
CLOPYRALID	1322.2	936.4	8496.4	202.8	4427.4		18.8	9037.2	10649.0	8498.5	12138.3	170.7	720.3	56618.0
COPPER NAPHTHENATE		10.8	6.1	2.2	5.9			13.1	2.6	10.4	6.3		2.4	59.8
COPPER OXYCHLORIDE	69.5							580.0						649.5
COPPER SULPHATE	83.5				0.6			0.2	586.5		1.3			672.1

Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
COPPER SULPHATE (TRIBASIC)	75.5	0.4	1.6		23.5			17.1	6.0	2.1	3.4		1.3	130.9
COUMAPHOS		0.06	0.03					6.4			0.9			7.3
CREOSOTE					7.6			16.1	3.8		30.3	0.5		58.1
CUPRIC HYDROXIDE					69.3			799.0	2436.5		248.9		3331.3	6885.0
CYANAZINE									45.0					45.0
CYCLOATE					460.8									460.8
CYFLUTHRIN	49.4	0.7	8.9		1.1			5.9	12.0	0.6	9.0	3.8	0.9	92.3
CYHALOTHRIN-LAMBDA		84.1	571.1	120.4	436.3		8.6	310.0	656.6	1134.5	1408.1	162.4	232.2	5124.4
CYMOXANIL								7.6	58.3					65.9
CYPERMETHRIN	1.3	0.06	0.3		9.6			5.7	6.6	0.6	0.7		1.4	26.1
CYROMAZINE	5.4				4.4									9.8
DAMINOZIDE	98.6				21.3									119.9
DAZOMET					78.4									78.4
D-CIS. TRANS ALLETHRIN	1.9	0.5	0.2	0.09	0.8			1.4	0.2	0.3	0.2	0.003	0.2	5.7
DEET	738.8	211.9	223.9	40.6	638.3			984.0	102.5	159.8	197.4	8.9	107.2	3413.3
DELTAMETHRIN	2.5	92.1	590.1	37.4	137.4		0.5	362.6	432.2	247.7	640.7	149.3	42.7	2735.1
DESMEDIPHAM					3.0				1147.5		18.0		180.0	1348.5
DIAZINON	2041.6	55.1	421.6	0.9	743.9			836.2	638.9	37.7	108.1	3.4	262.6	5149.9
DICAMBA	10390.4	1711.1	4951.2	249.6	4798.9		1169.4	5470.1	32129.4	3948.3	23127.9	2041.5	31434.9	121422.7
DICHOLOBENIL	136.8	12.4	36.2	0.9	109.9			88.0	198.2	36.1	41.1	2.2	22.8	684.7
DICHLORPROP	684.0		6661.5		8136.1		358.2	1008.0	27934.5	81.0	6493.8	405.0	5688.0	57450.1
DICHLORVOS	106.1	11.3	10.4	0.7	14.9			23.0	5.2	5.8	12.6	0.4	3.2	193.5
DICLOFOP-METHYL			28.7					105.1	234.3		185.3		161.8	715.2
DICOFOL	42.0				4.5				10.5		27.0			84.0
DIDECYL DIMETHYL AMMONIUM CHLORIDE	167.4													167.4
DIFENOCONAZOLE	1.2	284.7	1659.5	13.3	1669.8		89.5	1273.8	2033.9	906.2	2165.3	9.6	960.8	11067.6
DIFENZOQUAT		328.0	412.0		132.0			630.0	1028.0	372.0	678.0		884.0	4464.0
DIFETHIALONE	0.06							0.00007						0.06

Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
DIFLUBENZURON	2.6													2.6
DIMETHOATE	311.9	5.2	46.5	9.6	251.8			90.6	470.7	68.8	116.8	0.1	319.1	1691.1
DIMETHOMORPH					5.4				4.5					9.9
DI-N-PROPYL ISOCINCHOMERONATE		1.0	0.2	0.1	1.1			1.7	0.1	1.0	0.6		0.0	5.8
DIPHACINONE	0.3	0.0004	0.02	0.0006	0.03			0.03	0.01	0.01	0.002	0.001		0.4
DIQUAT	436.4	946.6	2580.3	24.0	414.6			3088.5	10547.8	2438.9	3586.7	48.0	1412.6	25524.4
DITHIOPYR									0.05					0.05
DIURON	28960.0		0.3	0.1	480.1			72.5	582.4		0.4	0.038	1000.5	31096.3
DODEMORPH-ACETATE	41.2				1.6									42.8
D-PHENOTHRIN	5.1	0.1	0.1	0.04	0.4			0.6	0.1	0.05	0.1		0.1	6.8
D-TRANS ALLETHRIN	48.2	2.0	2.3	0.7	6.1		0.02	10.2	245.7	2.3	1.7	0.1	1.3	320.6
ENDOSULFAN	193.2				68.0			272.5	4648.0	8.0	8.0		32.0	5229.7
ENDOTHALL									44.3					44.3
EPTC			16.0		24.0			688.0	7624.0	8.0	976.0		2608.0	11944.0
ERGOCALCIFEROL	0.002				0.0002									0.002
ETHALFLURALIN		1760.0	8273.2	204.2	4757.7		1943.2	4773.3	53663.8	22634.0	18493.0	589.7	51042.9	168135.0
ETHAMETSULFURON METHYL		32.9	79.9	4.6	37.7		0.7	121.0	154.7	282.2	105.1	9.1	16.4	844.4
ETHEPHON	40.8				2.4				7.2		64.8			115.2
ETHION		1.08	1.0					1.2	0.2	0.5	0.4	0.2	0.1	4.6
ETHOFUMESATE					4.8				6532.8		72		1132.8	7742.4
ETRIDIAZOLE	84.3	0.000005			37.8			0.005	0.0003	0.0001	0.002	0.00003		122.1
FATTY ACID	58.0	3.2	2.6	0.8	7.9		0.06	9.7	1.9	1.8	1.6	0.06	1.4	88.9
FENBUTATIN OXIDE	18.4				3.8									22.1
FENHEXAMID	2.5													2.5
FENOXAPROP-ETHYL			0.001					0.003	0.005		0.003			0.01
FENOXAPROP-P-ETHYL	0.5	2503.4	9159.4	248.2	4630.5		160.7	8540.0	11724.8	6329.2	13683.8	1036.2	6195.3	64212.1
FENTHION		72.1	52.3	12.3	9.6			57.7	33.7	40.6	86.9	10.7	42.8	418.8
FENVALERATE			1.2		0.7			0.6	1.1	0.04	0.2			3.8

Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
FERBAM	84.3				4.1			5.0	1.4				0.5	95.1
FERRIC PHOSPHATE	5.6	0.1	0.2	0.06	3.3			1.0	0.3	0.4	0.3		0.1	11.3
FEROUS SULFATE	1151.7	26.3	32.2		180.4			93.7	61.1	11.1	28.3		8.7	1593.4
FLAMPROP-M-METHYL											0.1			0.1
FLORASULAM	5.28	152.6	960.7	45.5	546.5			914.5	789.2	762.3	1179.9	30.0	704.0	6090.5
FLUAZIFOP-P-BUTYL		133.3	638.2		66.7		6.0	294.9	316.7	3423.9	541.4	133.3	254.2	5808.5
FLUCARBAZONE SODIUM		38.8	902.5		87.1		27.3	245.0	338.4	55.9	432.1	13.2	152.0	2292.2
FLUDIOXONIL	0.1	0.2	10.4	0.3	0.7		0.02	39.6	24313.8	3.1	7.3		2.1	24377.7
FLUROXYPYR		1045.7	7802.1	79.5	2109.6		4.6	6521.8	10883.8	4123.9	9753.4	27.6	814.8	43166.7
FOLPET	40.7		0.4	0.3	3.9			7.7	1.5	0.03	0.9			55.4
FORMALDEHYDE			17.8											17.8
FOSETYL-AL	336.3				15.5									351.8
GIBBERELLIC ACID	0.06													0.1
GLUFOSINATE	366.3	9640.6	15927.3	646.5	2736.2			32199.7	6616.2	23017.3	12365.1	458.4	3281.9	107255.5
GLYPHOSATE	32200.8	135286.9	585614.4	32420.4	219942.9		10788	619308.8	524789.8	412081.5	563128.4	44336.7	239923.2	3419822.1
HEXAZINONE	12.0	13.5	52.5		36.0			3.0	200.8	20.4	602.8			940.9
HYDRAMETHYLNON	20.2		0.1		0.02									20.4
HYDROGEN PEROXIDE	333.5								663.4					996.8
IMAZAMETHABENZ		7844.0	19910.2	1228.0	13122.0		249.5	23549.9	19832.0	19913.0	27637.7	369.4	4895.6	138551.4
IMAZAMOX		64.7	567.3	19.4	133.2		12.8	608.1	446.9	625.4	338.9	60.2	245.2	3122.0
IMAZETHAPYR		132.8	1291.0	20.2	143.3		12.8	1138.1	485.4	958.5	495.3	96.7	289.1	5063.2
IMAZYPYR	1675.8	6.8	4.6					9.1		13.7				1710.0
IMIDACLOPRID	31.1	1.9	823.5		3.1			48.2	11.2	47.0			12.0	978.0
IPIODIONE	1159.5	6124.2	4304.5	33.5	1326.2			5165.1	550.2	1014.5	919.0	2.5	415.0	21014.3
KINOPRENE	8.7				1.3									9.9
LIME SULPHUR	264.0	4.1	6.6	1.4	41.1			16.5	9.6	5.5	12.8	2.8	0.5	364.8
LINDANE		23.6	154.0		180.2		49.2	134.9	2830.6	291.0	619.5		496.4	4779.5
LINURON	5.0	4.8	1922.7	20.0	347.2			1617.0	3007.2	45.0	744.8	440.8	836.9	8991.4
MALATHION	1575.1	956.8	791.7	66.6	1244.8		26.9	1233.1	4680.7	538.4	5190.1	99.6	1009.9	17413.8
MALEIC HYDRAZIDE									1939.1				13.6	1952.7



Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
MANCOZEB	114.4	15.0	1846.7		58.5			1090.4	29752.6		2634.6		615.0	36127.2
MANEB		75.5	150.9	2.5	683.2		165.7	76.9	821.8	297.4	603.8		468.8	3346.4
MCPA	1282.2	41165.9	188169.1	9782.2	81653.2		2765.6	208938.5	125563.3	149444.1	244743.1	19203.4	24648.3	1097358.9
MCPB		7.5	240.0					350.3	992.3	100.5	27.0			1717.5
MECOPROP-D	2653.9	645.0	1851.5	130.3	4604.8		61.9	5310.2	3593.9	1337.4	2356.4	238.4	3308.0	26091.6
MEFENOXAM	24.2	23.7	592.3	0.9	201.0		7.5	1833.2	26272.4	73.7	477.4	0.8	305.8	29813.1
METALAXYL	1.3	61.1	23.5	0.8	22.1		0.1	30.6	92.3	11.6	33.5		25.2	302.2
METALDEHYDE	81.7	2.6	1.7	0.1	2.9			3.8	0.9	5.1	1.5	0.03	0.9	101.3
METAM			27.5		112.3			224.8	50.5					415.1
METHAMIDOPHOS			292.8		144.0			379.2	48.0		144.0			1008.0
METHIOCARB	12.1													12.1
METHOMYL	4.9	0.3	367.9		6.5			1.7	0.4	0.1	3.4		51.7	436.8
METHOPRENE	6.7													6.7
METHOXYCHLOR	18.6	0.5	0.6	0.2	2.0			2.0	0.2	0.3	0.2	0.03		24.7
METHYL ANTHRANILATE	4.1													4.1
METHYL NONYL KETONE	9.2	1.3	0.7	0.6	4.5		0.04	4.8	1.6	1.2	2.9	0.1	0.6	27.5
METIRAM					9.6			44.8	1948.8		60.8	4.8		2068.8
METOLACHLOR											11.2			11.2
METRIBUZIN		221.3	348.6		2.5			936.9	3822.4	54.6	749.8	15.8	154.5	6306.3
METSULFURON-METHYL	62.3	2.7	69.3		6.8		0.2	32.9	12.4	138.0	28.0	1.2	7.2	360.9
MINERAL OIL (INSECTICIDAL OR ADJUVANT)	1616.7	8.7	14.6	2.91	179.7			301.8	49.2	14.1	34.3	5.8	5.9	2233.7
MUSCALURE		0.007	0.006					0.04	0.01	0.003	0.08		0.003	0.2
MUSTARD SEED POWDER					284.0		1.7	1.7	169.0		14.8			471.3
MYCLOBUTANIL	123.8			4.9	13.4			1.6	15.0	3.8				162.6
NALED	36.0		121.8	196.2	7.8				58.8		434.4		117.6	972.6
N-ALKYL DIETHANOLAMINE	20.8													20.8
N-ALKYL DIMETHYLBENZYL								54.4	109.0					163.4

Active Ingredient Name	Alberta	Atha. River	Battle River	Beaver River	Bow River	Hay River	Milk River	North Sask. River	Oldman River	Peace River	Red Deer River	Sounding Creek	South Sask. River	Grand Total
AMMONIUM CHLORIDE														
N-ALKYL POLYETHOXYETHANOL	32.5													32.5
NAPHTHALENE		4.8			3.6			24.2	28.5	6.3	43.2	7.9		118.5
NAPROPAMIDE	65.7		0.9		49.0			14.1	21.7		5.0		2.7	159.1
NATURAL GUM RESINS	0.6				0.1									0.7
NICOSULFURON		2.3	27.2					12.6	54.9		37.9		5.1	140.1
NICOTINE	6.5				20.7									27.2
N-OCTYL BICYCLOHEPTENE DICARBOXIMIDE	12.9	2.0	1.4	0.1	6.9			4.0	1.5	1.9	2.0	0.1	0.6	33.4
NONYLPHENOXYPOLYETH OXYETHANOL	13765.6	3743.5	9751.7	1138.2	1129.5			9213.4	4661.7	4674.8	8316.7	578.2	2585.4	59558.8
OCTYLPHENOXYPOLYETH OXYETHANOL	41.6	8.4	820.1		479.1		95.8	1048.1	292.7	26.5	2187.3	11.3	134.0	5144.7
OCTYLPHENOXYPOLY ETHOXYETHANOL PHOSPHATE ESTER												60.5		60.5
OIL OF BLACK PEPPER	12.2	0.03	0.4	0.06	1.2			1.3	0.3	0.2	0.6		0.3	16.5
OXADIAZON	19.5				0.4									19.9
OXAMYL	2.4													2.4
OXINE BENZOATE	34.7		0.006		13.9			3.3	0.1	0.1	0.4			52.5
OXYCARBOXIN	59.6				125.8									185.3
OXYFLUORFEN					2.4			3.8	28.8				10.9	46.0
PACLOBUTRAZOL	0.2													0.2
PARADICHLOROBENZENE								4.4	5.1		2.8	1.6		13.9
PARAFFIN BASE MINERAL OIL		3742.1	21391.6	702.0	19273.7		308.0	24993.6	60012.5	7643.1	45386.3	774.0	8407.5	192634.4
PARAFFIN BASE PETROLEUM OIL		744.0	1464.6	91.2	812.0		14.4	2649.6	4123.8	13262.4	2502.0	144.0	2150.4	27958.4
PARAFORMALDEHYDE											68.3			68.3
PARAQUAT	14	2.6	16.6		26.6			167.7	1250.6	5.3	108.2			1591.6
PENDIMETHALIN									782.8					782.8



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PERMETHRIN	92.9	6.9	6.7	0.5	35.3			39.6	100.3	8.3	18.3	0.4	6.6	315.8
PETROLEUM HYDROCARBON BLEND		11124.7	94180.8	1679.7	33105.6		4934.8	89474.8	105592.6	71787.8	71634.0	9657.2	66556.8	559728.7
PHENMEDIPHAM					3.0				1147.5		18.0		180.0	1348.5
PHORATE									41206.5		199.5		11.3	41417.3
PHOSALONE	20.6				1.1			1.3	0.4				0.1	23.5
PHOSMET								0.5	140.0	0.2				140.7
PICLORAM	11912.7	226.6	809.6	84.5	498.5			1478.6	1371.7	276.0	1238.9			17897.0
PIPERINE	0.5	0.001	0.01	0.002	0.04			0.05	0.01	0.008	0.02		0.01	0.6
PIPERONYL BUTOXIDE	109.3	24.4	25.2	3.1	64.4		0.08	81.3	20.9	22.7	39.3	1.7	12.7	405.1
PIRIMICARB	33.8		0.1	0.08	11.8			1.9	60.4		0.2		54.0	162.2
P-MENTHANE-3, 8-DIOL		1.4	0.7	0.2	7.9			8.9	0.2	1.3	1.3		0.8	22.7
POLYMERIZED BUTENES	2.6				19.1									21.7
POLYOXYALKYLATED ALKYL PHOSPHATE ESTER		1012.2	1631.6	32.4	553.5		91.8	3245.3	1983.7	2151.9	1859.5	86.4	1079.6	13727.9
POTASSIUM MONOPERSULPHATE	59.9													59.9
PROMETRYNE													586.3	586.3
PROPAMOCARB HYDROCHLORIDE	246.9								165.0					411.9
PROPANIL			16.0								80.0			96.0
PROPETAMPHOS								0.3						0.3
PROPICONAZOLE	231.2	358.8	1347.0	43.8	843.4			1705.0	2235.8	629.6	4076.4	36.3	1676.3	13183.4
PROPOXUR	59.0	3.4	2.4	0.2	16.3		0.04	11.3	6.4	3.6	3.4	0.2	0.9	107.2
PROPYZAMIDE	9.5	2.0	7.8	4.0	26.4			46.0	10.5	25.7	47.6			179.4
PYMETROZINE	1.26		0.2					39.8	53.8					95.0
PYRACTLOSTROBIN		39.0	45.5		13.0		35.8	427.7	192.4	128.4	104.0		277.9	1263.6
PYRAZON								3.9	334.1					338.0
PYRETHRINS	24.9	6.8	13.2	1.9	101.4		0.0004	34.1	13.1	6.0	14.5	0.3	4.8	220.9
PYRIDABEN	21.0				2.5									23.5
PYRIDATE											12.6			12.6

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QUINCLORAC		16.5	30.0					233.5		526.4	71.8			878.1
QUINTOZENE	4812.7	166.6	32.2	89.3	800.9			287.6	471.4	260.3	133.9	14.9	96.7	7166.5
QUIZALOFOP P-ETHYL		119.0	219.6	14.6	129.9		2.304	420.5	674.4	2120.4	393.4	23.0	343.7	4461.0
QUIZALOFOP-ETHYL			32.4					6.9	0.8	2.3	1.5		0.8	44.7
RESMETHRIN	2.0	1.1	0.7	0.2	2.4			3.7	0.5	1.9	4.5	0.02	0.4	17.5
RIMSULFURON			0.1					9.8	208.9		0.2			219.1
ROTENONE	13.5	5.2	5.7	0.2	6.9		0.1	11.7	4.9	5.9	4.9	0.7	2.1	61.7
SAFER'S INSECTICIDAL SOAP	357.6	0.8	0.7	0.2	671.3		0.04	1.4	0.9	1.1	0.9	0.0	5.3	1040.2
SETHOXYDIM		831.6	5819.6	65.8	247.0		20.8	5737.6	6490.0	8139.9	1941.3	72.8	1626.6	30993.1
SILICA AEROGEL		81.0	400.5		666.0		175.5	130.5	4333.5	243.0	594.0	4.5	1156.5	7785.0
SILICON DIOXIDE	4709.7	294.8	497.0	40.2	1487.2		19.5	913.2	3610.8	644.8	1391.9	7.2	1971.9	15588.2
SILOXYLATED POLYETHER	1130.9													1130.9
SIMAZINE	427.2	0.7	24.4		80.1			1.4	450.4	1.8	165.4	0.1	8.9	1160.4
S-METOLACHLOR								5.6	2617.7		252.5		403.1	3278.9
SOAP	340.8	18.0	13.7	3.6	292.5		0.01	175.2	39.2	22.1	36.5	0.3	5.3	947.2
SOAP (HERBICIDAL)	28.0	4.8			4.8				4.8					42.4
SODIUM ALPHA-OLEFIN SULFONATE					180.2		1.1	1.1	107.2		9.4			299.1
SODIUM CHLORATE	6.8		6.9	2.7	2.1			11.4	0.3		9.6	0.9	12.3	53.0
SODIUM METABORATE TETRAHYDRATE	15.1		15.3	6.0	4.7			25.3	0.7		21.3	2.0	27.3	117.5
SPINOSAD FACTOR A PLUS	1.9													1.9
STREPTOMYCES GRISEOVIRIDIS	0.04													0.04
STREPTOMYCIN	1.0													1.0
STRYCHNINE	1.8	0.1	82.4		12.1		0.01	48.6	25.5		40.4	33.6	0.2	244.8
SULFAQUINOXALINE		0.01	0.06	0.002	0.05			0.09	0.07	0.03	0.06		0.0	0.4
SULFOSULFURON		16.0	132.4		26.9			177.1	28.4	101.6	113.0		1.0	596.3
SULPHUR (FUNGICIDE)	515.4	84.5	516.9	3.9	204.9			1538.4	34.0	26.1	34.9		9.2	2968.1
SULPHUR (INSECTICIDE)		17.3	4.2		7.1			23.7	8.9	29.8	5.6			96.6

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SULPHUR (VERTEBRATE CONTROL)	23.8	1.7	15.1	0.9	63.1			49.5	11.4		19.9			185.4
SURFACTANT BLEND	835.2	9177.2	66855.4	1467.1	26188.1		1561.9	68652.8	95885.8	64009.8	64332.6	3898.0	35372.0	438235.7
TALL OIL FATTY ACIDS	168.8				6.4						0.8			176.0
TALLOW FATTY ACID AMINE ETHOXYLATE										9.6			128.5	138.1
TEBUCONAZOLE		68.6	964.7	14.2	702.7		8.3	386.6	1997.7	12.5	1437.2		329.9	5922.4
TEBUFENOZIDE	8.64													8.6
TERBACIL	8.0				1.6			1.6	137.6			1.6	182.4	332.8
TERBUFOS			2.0		12.0			43.0	2318.0		3.0		515.0	2893.0
TETRAMETHRIN	10.6	1.3	1.1	0.1	1.4			3.1	0.5	0.9	0.9	0.1	0.4	20.3
THIABENDAZOLE			4.6		1.6		7.0	1.8	1283.9		8.7	2.3	78.9	1388.8
THIAMETHOXAM	14.7	19.4	463.1	22.4	57.7		1.9	141.4	72.9	243.5	138.7		0.4	1176.2
THIFENSULFURON METHYL		487.1	1785.8	126.1	630.3		13.1	1750.1	849.5	1169.6	1396.5	161.0	203.1	8572.3
THIOPHANATE-METHYL	162.4	4.2	2.8	0.1	62.5			67.4	10.9	17.9	15.5	0.009	111.0	454.7
THIRAM	642.6	395.9	4210.1	129.9	3250.7		31.5	3857.6	6230.7	2603.4	3653.1	60.7	2070.1	27136.3
TRALKOXYDIM		2947.2	16998.6	561.6	16717.4		246.4	18893.7	39671.3	5780.8	33833.1	619.2	4956.8	141226.1
TRIADIMENOL			16.8	22.8	21.6				6.0	19.2	33.6			120.1
TRIALATE		2186.0	28703.5	4590.0	12807.3		1884.1	7556.5	58216.3	1921.6	38834.3	3384.6	37137.3	197221.4
TRIASULFURON			14.0		2.3			97.4		29.3	47.2			190.3
TRIBENURON METHYL		235.1	1002.7	68.3	363.8		19.0	918.9	1046.5	562.3	892.6	91.3	204.2	5404.8
TRICHLORFON		80.3	151.7	35.5	39.0			436.6	1333.4	65.3	131.8	37.8	19.8	2331.3
TRICLOPYR	29625.6	552.0	471.4	211.2	168.0			811.2	624.0	57.6	115.2		480.0	33116.2
TRIFLURALIN		108.9	6451.0	310.7	5876.5		27.2	3828.8	4796.2	2932.2	7755.8	7847.6	719.4	40654.3
TRIFLUSULFURON METHYL									63.4		6.6		11.8	81.8
TRIFORINE	9.5	0.4	0.8		6.2			2.2	0.3	0.4	1.5		0.8	22.0
TRINEXAPAC-ETHYL	44.8													44.8
TRITICONAZOLE		120.9	341.7		195.3		4.0	268.8	521.0	76.4	445.1	21.4	85.8	2080.4
VINCLOZOLIN		282.0	559.0		67.2			282.0	9743.9	3666.0	937.8		8786.4	24324.3
WARFARIN	1.4	0.09	0.07	0.001	0.05			0.1	0.08	0.07	0.1		0.1	2.0

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WATER SOLUBLE DYES	45.8								2.9					48.7
ZINC NAPHTHENATE	13.8	2.1	1.1	1.2	1.0			2.7	0.1	1.5	0.1		0.2	23.6
ZINC PHOSPHIDE	18.0		1.0					76.3	339.0		1.0			435.3
ZINEB	9.5	4.8	10.5	1.8	6.7		0.9	24.1	20.5	2.0	8.3	0.5	10.0	99.5
Grand Total	213905.0	304878.8	1312404.8	70728.4	650317.2	0.45	41913.2	1362779.6	1920942.9	918463.9	1552223.6	128877.4	787052.5	9264487.7





